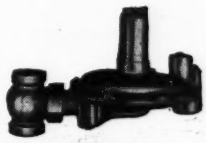
No. 00 DOMESTIC METER

FLOW INDICATING METERS



SERVICE REGULATOR—173

No. 0, 1 and 2 DOMESTIC METERS

SERVICE REGULATOR—107

No. 2½, 3 and 4 CAST IRON METERS

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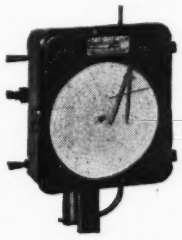

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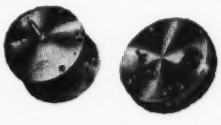

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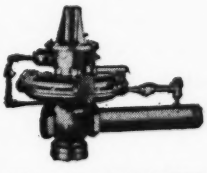

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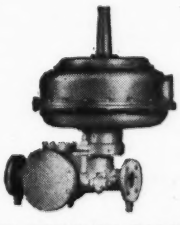
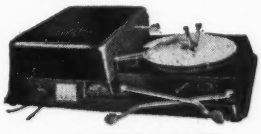


LOW PRESSURE BALANCED VALVE REGULATORS—014



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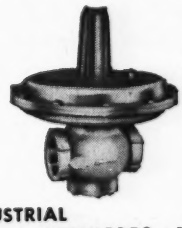

INDUSTRIAL REGULTORS—120

HIGH PRESSURE—015 LEVER AND WEIGHT CONTROLLED REGULATORS

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GAS

• *28th Year of Publication*

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Contents

Seven Years Experience With Plastic Services 45
By Gordon G. Dye

Plastic Tubing Is Making Strides 49

Safety in the Regulation of Gas Pressures 51
By Allen D. MacLean

Corrosion Control Trucks 58
By F. O. Waters

Magnesium Ribbon Anode 60
By H. A. Robinson

An Industry Need: Standardization of Truck Bodies 66
By Brooke Daly

External Sealing of Bell and Spigot Joints on Cast Iron Mains 69
By Frank V. Wilby

Proved Reserves Now 194 Trillion 74

Portland's New Security Manual Blueprints Emergency Procedures ... 76
By R. H. Glassley

McCall's Test Rooms Play Dual Role in Checking Gas Appliances ... 78
By Albert P. McNamee

Combination Manual-Automatic Domestic Water Heater Patented ... 84

Ohio Fuel Tells Why There's "Shortage in the Midst of Plenty" 86

PIPELINE SECTION

Valve Positioners: Part 1. Their Applications in the Gas Industry 123
By C. S. Beard

Refrigerated Extraction Plant Processes 750 MMcf Per Day 128
By J. J. King and R. V. Mertz

Pipeliner's Cradle 136

Line Pipe 138
By Karl L. Fetters

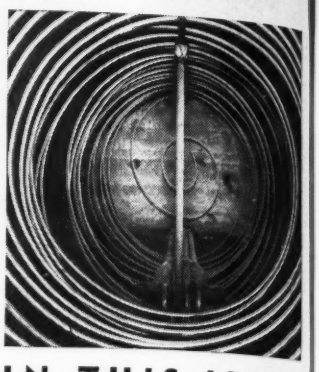
Spanning the Mississippi for Chicago Line Termed "Toughest Crossing" 148

COMMENT

Highlights ..... 37 Thermally Thinking 39
Technical Trends, *by Guy Corfield* 43

DEPARTMENTS

News ..... 88 Trade Literature 114
Calendar ..... 95 Associations 116
Current Reading .....102 Pipeline News 150
People .....104 Pipeline People 157
New Products .....110 Progress Reports 159
Advertisers Index 162



IN THIS ISSUE

Magnesium ribbon, spiralling down into large water tank, protects it from corrosion. Results of experiences with this ribbon are detailed by H. A. Robinson on pp. 60-65.

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Publication Office
198 South Alvarado St.
Los Angeles 4, California
Phone DUnkirk 7-4337

Advertising & Editorial Offices

CHICAGO
DAVID CARMEN, District Manager
1064 Peoples Gas Building
WAbash 2-2589

CLEVELAND
JAMES K. GILLAM, District Manager
1836 Euclid Ave.
PRospect 1-4584

NEW YORK
RAYMOND M. SCHUSTER, District Manager
PETER WILE, Assistant District Manager
11 West 42nd St.
CHickering 4-1969

TULSA
CRAIG ESPY, District Manager
P.O. Box 4055
2-2414 (bus.), 7-9807 (res.)

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technical trends

by guy corfield

Underground Coal Gasification

THE GASIFICATION OF COAL in place underground, to recover at least a large portion of its thermal value as usable fuel without the expense of mining and surface handling, has not been developed into a dependable and economical process, but it is being pursued industriously and persistently with rather definite promise of ultimate success. The gas industry should watch this development closely as it may well provide the future major source of pipeline gas to fill the big transmission lines when, as seems to be expected, natural gas is no longer able to supply the demand.

The first serious approach to this undertaking was in England in 1913. In 1933 Russia started experimenting and had a semi-industrial works producing in 1936. Sweden, Estonia, and Germany experimented with oil shale beds, Belgium and France did some work with coal deposits, and Italy attempted gas production from lignite. In the United States the work at Gorgas, Ala., jointly performed by the U. S. Bureau of Mines and the Alabama Power Co., has continued since 1936 and been described in two reports, the latter entitled "The Second Underground Gasification Experiment at Gorgas, Alabama," Bureau of Mines Report of Investigations, 4808, October 1951. The very general plan has been to create a horizontal tunnel or passage through the coal seam, connecting at each end to a vertical shaft or "borehole" from the surface, promote ignition at one end of the tunnel by means such as an incendiary bomb lowered down the borehole, and then force air down the same borehole to maintain partial combustion and force the products through the tunnel and up and out of the other borehole.

The results to date have not been very satisfactory as relatively small quantities of gas have been produced with heating value not above 150 Btu per cubic foot and usually considerably lower. Apart from the problem of creating the tunnel in the first place, its necessary size even at the start not only requires large quantities of air which dilute the products, but also results in excessive absorption of heat underground. However, considerable basic information and experience have been gained with respect to such fundamentals as practical distance between boreholes, optimum rate of air injection, size and shape and final structure of burned-out area, temperatures, back-pressures, etc.

Concurrent with the work at Gorgas, the School of Mines and Metallurgy of the University of Missouri has been conducting original research, supported by school funds through the laboratory stage until 1948, and thereafter financed cooperatively with the Sinclair Coal Co. of Missouri, on what is termed underground "electrocarbonization" of coal and related hydrocarbons (oil shale and tar sands). The important and attractive feature of this development is that the whole process can be conducted from the surface through small-diameter boreholes only, i.e., it is shaftless and driftless in that no large entry openings have to be made either vertically or horizontally.

Stated simply, two holes are drilled to the coal seam and steel pipes about three inches in diameter are inserted which serve both as *electrodes* and conduits for air and gas. Electric voltage is applied with resultant flow of current between the electrodes through the coal, which both heats the coal and forms a permeable channel through it. This is called "electrolinking" and, if the current flow is continued, the volatile matter in the coal is released in a manner analagous to the coking process for coal, and a gas is produced from the pipe electrodes. This gas has a Btu content of about 500 to 550, and this phase of the process is termed "electrocarbonization."

When the volatiles have been expelled, the electric current can be shut off and air introduced through one pipe and the remaining coke converted to producer gas of about 150 to 200 Btu which comes out of the other pipe. This phase is somewhat similar to the Gorgas procedure except that, even though the reacting fuel is essentially coke rather than raw coal, a higher Btu is produced because the "channel" is smaller so that more intimate contact between coke and air is gained and a minimum amount of excess air is required.

A modification of this procedure, whereby air would be injected simultaneously with application of electric current (as soon as "electrolinking" had been accomplished), presumably to form a mixture of coal gas and producer gas, is considered feasible and has been termed "electrogasification." This general process appears to be sufficiently developed to indicate its economic practicability, and the "electrolinking" procedure has been used at Gorgas by the U. S. Bureau of Mines to prepare a site for a new underground gasification experiment. Anyone interested in additional data can obtain a bulletin, "The Process of Underground Electrocarbonization," dated January 1952, either from the Missouri School of Mines, Rolla, Mo., or the Sinclair Coal Co., Kansas City, Mo.

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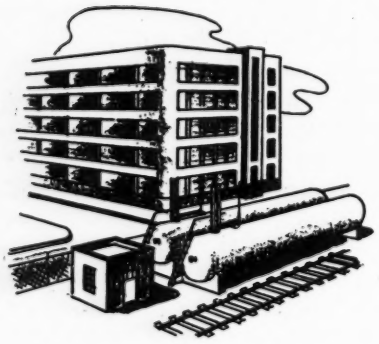

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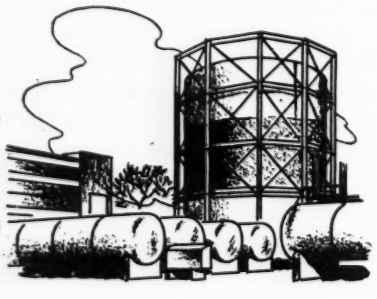

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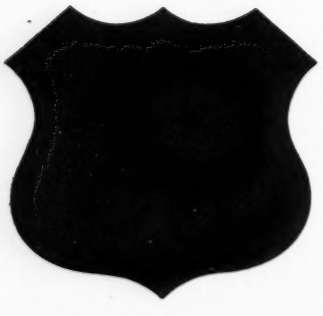

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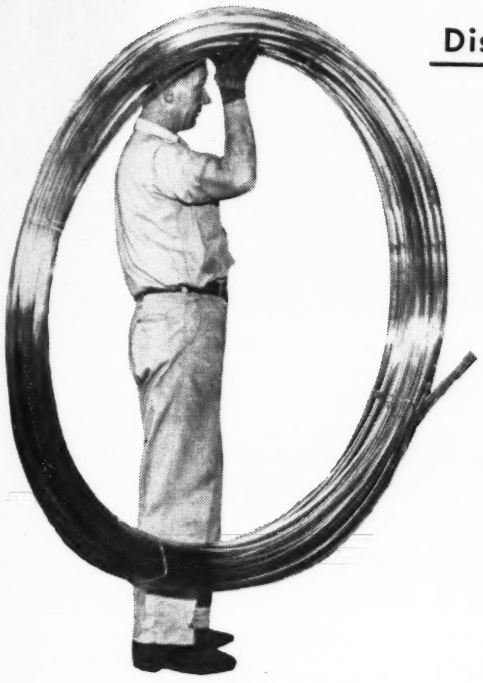


Seven Years Experience With Plastic Services

By GORDON G. DYE
Southern California Gas Co.
Los Angeles

GAS magazine, in the July, 1944 and October, 1946 issues, published articles discussing the testing and use of plastic tubing for gas service piping by Southern California Gas Co.[1] The purpose of the present article is to record any worthwhile changes or improvements in procedures or techniques which have been made since the former articles were published, and to give a progress report on the use of plastic tubing by this company.

Exclusive

Progress Report

Table 1 shows the amount of plastic tubing which has been used by Southern California Gas Co. as gas service pipe.

The variations in quantity installed per year are due to the availability of plastic, steel, and copper at given times and to our desire to see if any weaknesses developed in the plastic in actual service.

All of this tubing is still in service, except very small quantities which have been removed in connection with service alterations due to customers' remodeling buildings, construction work in the streets, etc.

Sampling inspections of plastic tubing in service have revealed no defects or mechanical weaknesses which would indicate that plastic tubing may not be satisfactory for underground gas service piping. Furthermore, field personnel is instructed to report all cases of damage to or leaks in plastic tubing or connections. No disturbing case has been reported, and no change in the physical characteristics of the plastic can be detected. This statement, however, relates to natural gas conditions. There is some evidence that this plastic (Tenite II) is not resistant to aromatic hydrocarbons such as are present in manufactured gas.[2]

Occasionally the tubing has been broken or damaged at the time of installation but, insofar as is known, all these cases were noticed at the time. Possible exceptions to this are the three cases of leaks mentioned below. Leaks sometimes developed at the flare-type compression fitting which was used at first to connect the plastic to the service tee or riser.[3]

Other than these things, only the failures listed below have been discovered or reported:

Two cases where the tubing was burned by a kerosene flare[4] which fell (or was thrown) into a bell hole.

One case where a plumber, digging for a water line in the customer's yard, cut the tubing (½-in. flexible) with a shovel.

Two cases where customers spading in their yards damaged plastic tubing.

One case where a dump truck loaded with sand backed into a newly filled service trench, near the service riser, during wet weather and broke the tubing.

One case of a leak at a plastic coupling connection.

One case where a meter set assembly construction crew twisted the service riser and caused a leak at the plastic-service riser connection.

One case where a plastic tubing was found broken inside the old steel casing.

One case of a leak at a compression nut-

[1]This information is also printed in the *Proceedings* of the Pacific Coast Gas Assn. for 1944 and 1946.

[2]Results of chemical and physical tests made in 1946 or before are given in the article published in *GAS*, October, 1946.

[3]This fitting is illustrated in the 1946 article.

[4]Used along open ditches, etc. at night.

TABLE 1. Plastic Tubing Installed As Service Pipe

Year Installed	Quantity in Feet: New Services	Quantity in Feet: Service Replacements
1945	1,700	
1946	22,111	
1947	50,693	
1948	22,787	
1949	5,343	
1950	356	
1951	33,589	276,686
Totals	136,579	276,686

plastic reducer connection. Apparently the compression nut had not been tightened enough.

One case of a leak at the plastic reducer-plastic tubing connection.

Inasmuch as heat will cause plastic tubing to melt or deform, welding cannot be done near it. Furthermore, our standard pipe coating for corrosive soils which employs the use of hot asphalt is not used on the boltless line couplings and service tee connections. Instead, a coating made up as follows is used:

A heavy coat of grease containing a rust inhibitor.
One wrap of cellulose acetate.
A light coat of grease containing a rust inhibitor.
One wrap of cellulose acetate.
One wrap of kraft paper.

Sampling inspections of installations indicate that this method of protecting is satisfactory. While our experience with this coating for this particular purpose covers only five or six years, the same general type of coating on mains has given satisfactory performance for a much longer time.

With respect to effects of temperature, plastic tubing, especially the flexible, tends to expand or stretch if subjected to higher temperatures and sustained higher pressures—say 85° F and 100 lb or above for long periods of time. We limit plastic use to 60-lb pressure and do not expect ground temperatures as high as 85° F. Also, the tubing becomes more brittle and rigid as its temperature decreases. Some laboratory tests which we conducted on ⅝-in. flexible tubing indicated the following:

1. The impact strength of Tenite II plastic tubing at 0° F is about half that at 80° F. The failure at 0° F is more serious since a piece of the tubing is usually knocked out, while the failure at 80° F may consist of only bending the tubing and slight cracking.
2. The bursting strength of the tubing is not affected by temperatures as low as 0° F. However, failure at 0° F usually shatters the tubing rather severely while, at room temperature, the failure may consist of only one crack.
3. Impact blows on the tubing at 0°F do not change the bursting strength if they do not produce a visible fracture.
4. The stress introduced in the plastic tubing because of temperature change and shrinkage when the ends are held rigidly is only about one-tenth of the stress required to fracture the tubing in tension.
5. Bending of ⅝-in. plastic tubing is not harmful to the tubing when at temperatures as low as 0° F, since a 1-ft length of the tubing at 0° F was bent around a 3½-in. radius without failing.
6. It is not expected that any difficulties would be experienced either during installation or while the tubing is in service at temperatures as low as 0° F.

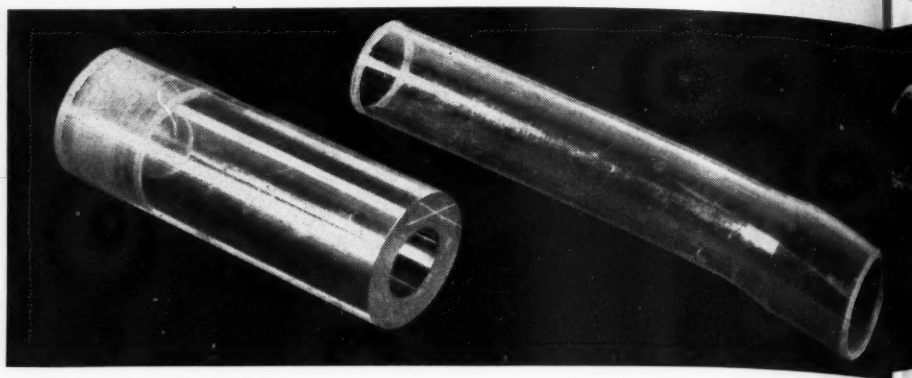


Fig. 5. Plastic reducer.

Fig. 6. Plastic protective sleeve, 1-in. x 6-in.

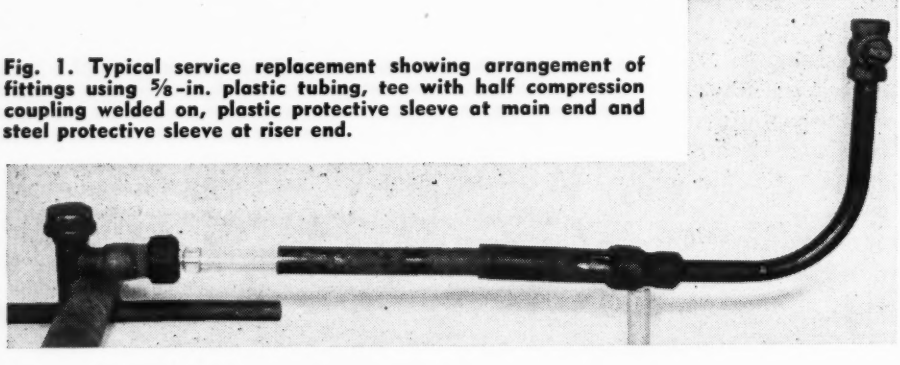
In connection with developing a procedure for closing ends of broken tubing, it was observed that while 1-in. rigid tubing crushed satisfactorily at 40° F, it might fracture or develop heavy cracks at 35° F before it completely closed.

Developments and Improvements

Perhaps the most important development in our case is the use of flexible plastic tubing for service replacements, where the old service pipe is used as a casing. Governmental restrictions on the use of copper tubing caused us to consider the use of flexible plastic tubing for service replacements since considerable savings can be made in labor and resurfacing charges if a smaller flexible pipe or tubing can be inserted in the old pipe. Also, there is less inconvenience to customers and the public because of the fewer excavations necessary.

Early in 1950, when the use of copper was restricted, the supply of plastic material was limited, and it was necessary for us to convert an outstanding order for 1-in. rigid plastic tubing to ½-in. nominal (⅝-in. OD) flexible tubing if the practice of replacing service by inserting was to be continued. The tubing has a wall thickness of .060, weighs about 1 lb per 18 ft and was delivered in 200-ft coils about 5 ft in diameter.

Fig. 1. Typical service replacement showing arrangement of fittings using ⅝-in. plastic tubing, tee with half compression coupling welded on, plastic protective sleeve at main end and steel protective sleeve at riser end.



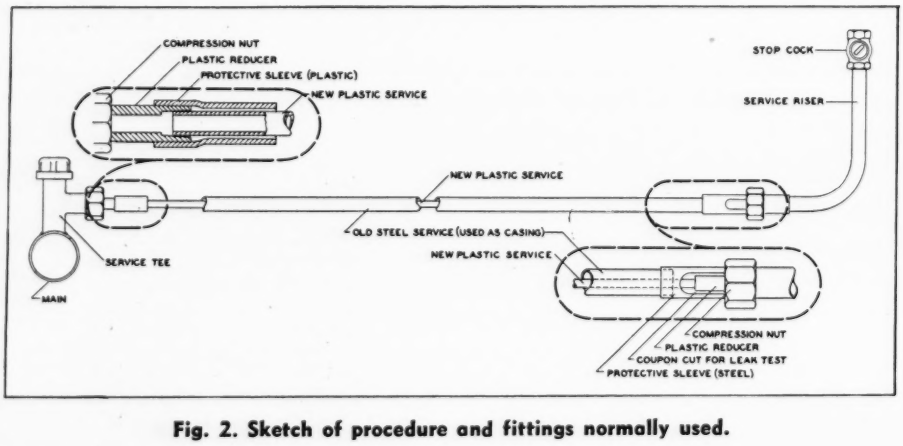


Fig. 2. Sketch of procedure and fittings normally used.

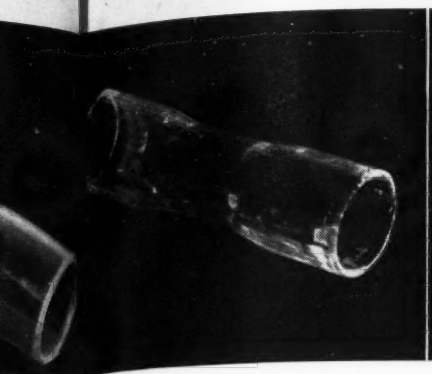


Fig. 7. Belled coupling, ½-in. ID.

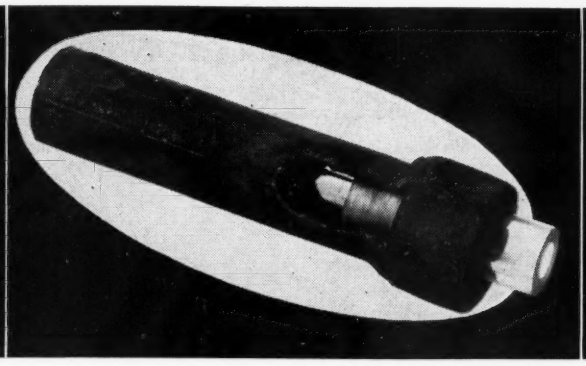


Fig. 8. Nipple cut from old pipe welded to outside end of compression nut.

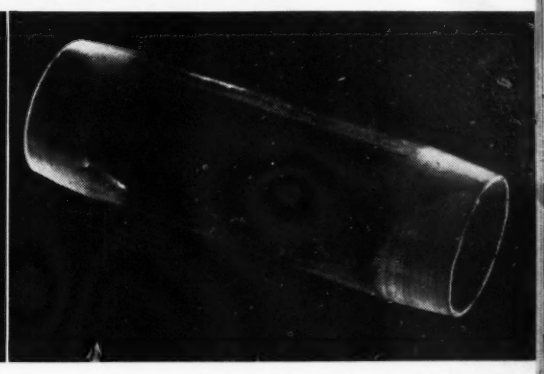


Fig. 9. Internal sleeve with tapered ends.

Figs. 1 and *2* show the procedure and fittings normally used.

The plastic reducer *(Fig. 5)* is a heavy-walled tube 3 in. long. It is 1.060-in. OD x .500-in. ID, and has a tapered counter bore .627 in. x .613 in. in one end. The ½-in. nominal flexible tubing is cemented into this counter bore.[5] The reducer is connected to the service tee or riser by a compression type coupling. This coupling is one-half of a conventional double ended boltless coupling welded to the riser *(Fig. 4)* or the outlet of a standard service tee, or it is forged as an integral part of a specially designed service tee *(Fig. 3)*. In the event that the old service casing is not in alignment with the outlet of the service tee, an offset steel pup is fabricated in the field. The half compression coupling is welded to one end, and the other end of the pup is welded to the outlet of a standard service tee.

The use of external plastic sleeves, of a uniform inside diameter, for connecting two pieces of plastic tubing has been discontinued, and belled couplings are used instead to assure contact *(see Figs. 6* and *7)*. The belled portion of the couplings is tapered the same as the counter bore on the reducer. This taper was found to be necessary because the fabricators are unable to maintain close tolerances on the outside diameters of plastic tubing. It can be said, however, that fabricators are improving their techniques and are working to closer tolerances than formerly.[6]

All plastic fittings are fabricated in our shops from tubing and are included in the standard stock of the maintenance trucks. This procedure appears more satisfactory than the alternative of providing each truck with belling tools and a means of heating water, which is necessary to soften the tubing before it is belled.

It was observed during the first installations that the ½-in. tubing could be severely distorted, or even broken by large shovelfuls of wet, viscous earth or by tamping the backfill over the tubing if it had not been first compacted solidly beneath and up to the level of the tubing. Also, it was feared that settling of the earth after backfilling might place a heavy load on the tubing and cause distortion or leakage.

Consequently, field crews were requested to use particular care in protecting the ½-in. tubing between the steel-to-plastic connection and the end of the old steel casing and to report the methods used. This applied to both ends of the service, since gardening activities of customers might damage the unprotected tubing at the riser end. Evaluation of different methods led to the adoption of the following principles:

1. Soil must be well compacted to the level of the tubing before the fill is made to a higher level. This will prevent the settling of the earth placing a heavy load on the tubing.
2. Exposed tubing must be surrounded with fine soil, free from rocks, broken pavement, etc., to prevent denting or penetration of the tubing.
3. A standard method of protecting the exposed tubing was adopted. This method uses a 1-in. x 6-in. plastic nipple *(Figs. 1* and *2)*. The method does not necessarily provide the strongest protection, but it is simple, inexpensive, and judged to be adequate.

Some other satisfactory methods of protecting the exposed ½-in. plastic are given as a matter of interest and because they may be preferable under some conditions:

1. Cut a piece of old pipe (such as 2-in. junk) longitudinally and place one piece of it above and parallel to the unprotected tubing, after the latter has been covered with 2 or 3 in. of earth.
2. Weld a piece of pipe (new or used) 1½ in. or 2 in. in diameter to the outside end of the compression nut of the tee or coupling. Slide the open end of

Fig. 3. Service tee with compression connection as integral part of tee.

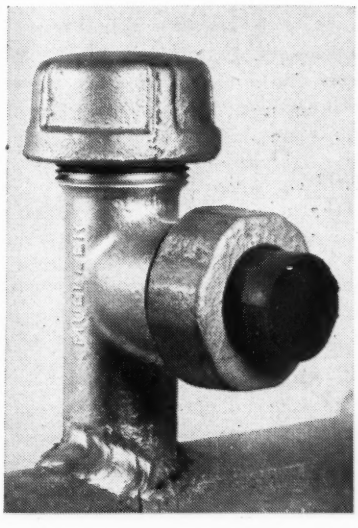
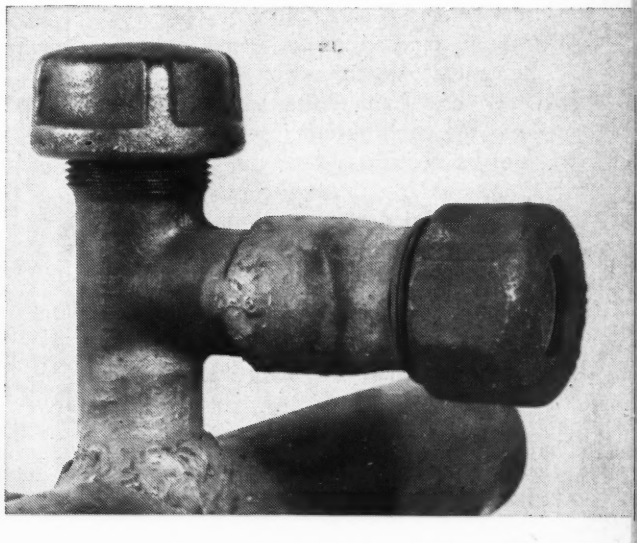


Fig. 4. One-half compression coupling welded to standard service tee.



[5]For results of tests of various cements and methods of application, see article in *GAS*, October, 1946.

[6]The plastic reducer-boltless coupling method for plastic-to-steel connections and the belled coupling method for plastic-to-plastic have been developed or further tested since 1946 and have proved superior to methods described in the article published then.

the nipple over the end of the old service, which is to be used as a casing, and insert the plastic tubing through the casing and nipple and nut assembly to the proper position in the tee or coupling. Tighten the nut in the usual manner, turning the complete nut and nipple assembly. To permit testing the connection for leaks, "peep" holes may be cut in the nipple near the nut *(Figs. 1, 2,* and *8)*. This method, if used at both ends, completely encases the plastic tubing in steel but may establish an electrical circuit. Even after steel pipe has has corroded to such an extent that it cannot be used to carry gas, it should provide considerable protection to the tubing for many years.

It may be worthwhile mentioning that the existing steel service to be used as a casing should be cleaned before the plastic tubing is inserted. Futhermore, it is advisable to push the tubing through the steel casing until 2 or 3 ft extend beyond the casing at the outlet end for inspection. If this short section shows deep scratches or cuts, the tubing should be removed and the casing reamed or a different method used for replacing the service. It is very rarely that the tubing is damaged to this extent.

We are now purchasing 1-in. nominal flexible tubing for use in replacing larger size services. An OD size of 1.161 in. was decided upon because this was considered to be the largest size that could be inserted in a 1¼-in. steel casing. We now have on hand several thousand feet of this tubing, but to date we have made only a few trial installations. All the refinements have not been worked out, but it appears that the procedure will follow closely that which has been adopted for the ½-in. size.

The plastic reducer will not be used to connect this tubing to the riser or the service tee. A short piece of 1-in. rigid tubing, tapered on one end, will be cemented to each end of the 1-in. flexible. This rigid tubing will fit directly into the compression type coupling. It will be necessary, as in the case of the 1-in. rigid plastic service, to use an internal metal sleeve to reinforce the tubing at the point where it is gripped by the compression coupling.

Another change in the assembling procedure of the 1-in. flexible tubing is that two pieces of tubing will be connected by means of an internal sleeve, tapered slightly on each end *(Fig. 9)*. The reason for using the inside sleeve, instead of a belled coupling, is to eliminate the shoulders which might catch on irregularities in the steel casing. Also, if a belled coupling were used, the OD of the coupling would have to be small enough to go through the 1¼-in. casing, and consequently the OD of the tubing itself would have to be still smaller which would cause an undesirable reduction in its capacity.

The article which was published in 1946 listed 15 conditions relating to the use of plastic tubing for service piping by Southern California Gas Co. These conditions still apply, except for minor modifications. For example, there seems no good reason now for prohibiting the use of plastic tubing for branch services nor for confining its use to mild soils. The newer fittings, described in the present article, of course replace types formerly used and mentioned in some of the points. Also, it has been found unnecessary to have plastic material in solution in the acetone. Better connections result from use of plain acetone and plastic fittings that contact, although caution must be used to keep from weakening the tubing walls at the end of the couplings.

TABLE 2. Comparative Costs

New Services	Direct Labor	Ratios Pipe & Fittings	Total Cost
¾" Steel (hot wrap)	$1.00	$1.00	$1.00
¾" H.D. copper	.97	2.22	1.16
1" Rigid plastic	.94	1.40	1.01
Service Replacements			
¾" Steel (hot wrap)	1.00	1.00	1.00
½" S.D. copper	.80	1.44	.88
½" Flexible plastic	.79	.94	.81

Miscellaneous costs are not shown separately, but are in the totals.

Comparative Costs

The comparative costs shown in *Table 2* were calculated by use of time study and other data. A typical 69-ft service was used and the data were weighted to obtain average condition for soil, pavement, boring, travel, and other factors. The figures do not include pavement replacement costs, however, because these costs vary considerably from locality to locality. This factor, in our case at least, would tend to increase the savings of inserting flexible plastic or copper over trenching or boring for steel.

There is no reason to change our former conclusion (1946) except to reflect a broader and longer experience: The ultimate life of plastic service pipe is still a matter of conjecture. From eight years of observation, however, it is considered likely that under proper conditions, plastic will last at least as long as steel.

Its installed cost compares favorably with that of steel for new services, and substantial saving can be made by inserting plastic in an old casing for replacements instead of excavating to install steel.

CHARACTERISTICS OF PLASTIC TUBING

The following are some advantages and disadvantages of the plastic tubing used by Southern California Gas Co. as compared with steel or copper.

1. It is not affected by corrosive action of soil.
2. It is a non-conductor of electricity and is not affected by electrolytic action.
3. It is light, easy to handle, and installation requires fewer man-hours than for steel. Field crews like it.
4. It cannot be located with an electronic pipe locator.
5. It is easier to cut, or to damage mechanically, than steel or copper.
6. It is combustible. (This characteristic, together with factors stated in No. 5, make it inadvisable to use plastic tubing aboveground, such as for a service riser.)
7. It can be closed by pinching ends of broken tubing.
8. Since it cannot withstand long periods of exposure to sunlight, truck stocks should be kept small, and the oldest should be used first so none will be exposed for more than a few days.
9. It tends to flatten if stacked in large piles or if heavy material is piled on top.
10. It cannot be held to the close size tolerances possible with copper or steel, although fabricating techniques are improving.
11. It has shown no evidence of fatigue or cold flow at normal temperatures.

Plastic Tubing Is Making Strides

Six companies are using it and many others plan to give it a try

PLASTIC tubing for gas service piping may "come of age" in 1952. Today it would appear to be on the threshold, as it were. Its immediate prospects may have been dimmed somewhat last month by the welcome (to utilities) news that copper, as well as steel, is to be relatively more abundant; and so, as a substitute, it may once more fade into the background. If it's to be a war baby, its destiny will follow the tides of war; on the other hand, if it finds its place as a tubing material that is just as good as copper or steel, it moves out of the emergency class, and will soon be one of the prime materials for use in gas services.

Exclusive

In an attempt to analyze the situation, *GAS* last month asked distribution superintendents in 64 major utility companies throughout the country about their experiences with plastic tubing. Had they tried it? Were they still using it? Were they contemplating using it? How was it working out?

The results of the survey may have been disappointing to plastic tubing manufacturers, although it did reveal the fact that they have a wide-open market that's virtually untapped. They certainly have an *interested* market.

Only a handful of utilities are using plastic tubing. Others have tried it and discovered that it simply did not measure up to their requirements. But some of these companies, as well as many others that have never tried it, are largely unaware of the intensified activity in research that has brought about basic improvements in plastic tubing that will go a long way toward answering their objections.

Another basic difficulty is the confusion that exists as to the varied types and applications. Plastic tubing is not simply plastic tubing, but it is many products moulded of many materials of varying properties, all engineered for particular uses. A single manufacturer compounds several formulas. One leading manufacturer says:

"Even among the various formulas we make up there are variations in properties to suit the desired application. These variations are multiplied among the several manufacturers so that there are on the market many types and grades of plastic tubing."

Thus, any analysis of tubing, to be scientific, must be confined to a single type, as in the case of the article just preceding this report. Southern California's experiences, as evaluated there, are confined to cellulose acetate butyrate and are applicable to that one material only.

Only six companies were found to be using plastic tubing. Considering the varying degrees of experience of each, it can be said that all are pleased with it. A Southern California Gas Co. engineer agrees that it may now be considered an "alternate" material rather than a substitute — a fine distinction, perhaps, but an important one in the lexicon of gas engineers.

One manufacturer states he is selling plastic tubing on its advantages rather than its availability.

In this connection, the statement of

Box Score

Of 64 major gas utilities queried . . .

- **6** companies are using plastic tubing and intend to continue.
- **5** have considered using it, but have either failed to put it to test or have discontinued the use of it.
- **4** companies are planning to test its possibilities.
- **49** companies have had no experience with it, but 24 of these expressed strong interest in its development and possibilities.

"Those in Favor . . ."

Mountain Fuel Supply Co., Salt Lake City, began testing plastic tubing in 1951 to determine if it could be safely used in a cold climate. Six thousand feet of the pipe was installed as new services during the year; this was the total service footage installed. In 1952 a similar amount will be placed in service.

Mr. Watkins reports no difficulties with its use.

At Denver, Public Service Co. of Colorado began experimenting with it last spring, installing 25,000 ft during the year. This was about 2% of the total pipe used (300 out of 15,000 services installed).

Public Service Co. uses it exclusively for new services. Initial experiences have been good and the company would probably continue to use it on an experimental basis even if steel pipe were to be available in unlimited quantities.

In Minneapolis, where plastic pipe was first used in 1948, the company has been installing 3000 to 5000 ft per year under street railway tracks where there was evidnece of stray current electrolysis. This represents about 1% of total service footage installed.

In 1952, the company is putting in between 5000 and 7000 ft, of which 1000 ft will be used for new services. K. W. Person opines that "it is good for the uses we have tried so far. In the field in the summer time it is good, but in the winter it is too stiff and brittle. Its advantages are that it is light and non-conductive, but it is not available here in coils like copper, and it is not as strong.

"We would continue using plastic tubing under any conditions of availability, for insulation purposes. We are satisfactorily using it in iron pipe sizes with compression couplings.

"We would like to use it for replacement liners inside old services if we could get plastic in coils or find a suitable internal coupling so that plastic could be pulled through old pipe. We are working on that now."

Comments from Distribution Superintendents

"We have very little information relative to plastic tubing. At the time a representative of one firm making plastic tubing called on our company, his firm was not in large scale production, and the prices quoted were very high. I am certain we will not use any large amounts until we are satisfied it will stand the conditions to which it will be subjected locally." H. W. Johnston, Gas Service Co., Kansas City, Mo.

"We will consider using it when the relative merits are equal to or exceed those of protected steel pipe." A. D. Simpson Jr., United Gas Corp., Houston.

"We do not think it has sufficient rigidity." Roy S. Brunner, Terre Haute (Ind.) Gas Corp.

"Local ground conditions require greater tensile strength." W. E. Tracy, Montana Power Corp., Butte.

"We do not anticipate the use of plastic tubing at any time in the near future because of soil and climate conditions." General superintendent, Philadelphia Electric.

"We are now studying the possibilities of using it for mains and service lines." W. F. Redd Jr., United Fuel Gas Co., Charleston, W.Va.

"We are awaiting further experimentation and adequate proof that plastic tubing is an adequate substitute for copper pipe in our soil conditions and temperature conditions." A. C. Cherry, Cincinnati Gas & Electric Co.

"We do not feel it is sufficiently well tested in gas services. Have used it for chlorine in water treating plants and it is proving successful." L. L. McNeil, Interstate Power Co., Dubuque, Iowa.

"We do not believe that plastic tubing is practical in the Berkshire hills." W. R. Stevens, Pittsfield (Mass.) Coal Gas Co.

"From what we know of plastic tubing in general I think it is too brittle at low temperatures and too low in tensile strength at any temperature to be generally used." C. C. Barr, Consolidated Gas, Baltimore.

K. W. Person, superintendent of distribution for Minneapolis Gas Co., is significant. He says:

"We would continue to use plastic tubing for insulation purposes even if copper tubing were plentiful."

Minneapolis Gas, incidentally, ranks as a "pioneer" in the study of plastic tubing, having adopted it for service replacement in 1948. It is used under street railway tracks where there is evidence of stray current electrolysis.

With Public Service Co. of Colorado, Denver, plastic tubing is still being used only on an experimental basis. If steel services were available in unlimited quantities, however, the company would still use it on an "experimental basis," according to Donald J. Miller, gas engineer. PSCo. uses it for new services exclusively.

Mountain Fuel Supply Co., Salt Lake City, also uses it for new services. In 1951, the first year the company had tried plastic tubing, 6000 ft, representing 100% of total footage installed, was laid. Superintendent of Distribution D. Watkins reports a similar amount will be used this year; to date the company is satisfied with its performance.

Cheyenne (Wyo.) Light Fuel & Power Co. installed about 500 ft of tubing in January 1952. O. P. Reed, superintendent, doesn't feel that the company has had enough experience with it as yet to venture an appraisal. It has not been decided whether more plastic tubing will be installed.

Southern Counties Gas Co., Los Angeles, began using it for service replacements last November.

In general, most of the companies who are not using it at present haven't had any experience with it. The majority of them have been blessed with sufficient, if not generous, supplies of steel services. Not having adopted the use of copper tubing for lining old steel services, these companies have felt no compulsion to investigate plastic tubing. As D. C. Benson of Memphis (Tenn.) Light Gas & Water Division, says, "Shortage of pipe may force us to consider it at a later date."

Nevertheless, these same companies *are* looking ahead and are obviously eager for more information.

The reaction of C. G. Minich Jr., of Delaware Power & Light Co., Wilmington, is typical. He says:

"Our plans to use plastic tubing have only been in the thinking and talking stage. No definite decisions have been made as yet. We would like to know more of the experience of others, both as to the material and methods of installation."

Roy E. Wright of NEGEA Service Corp., Cambridge, Mass., says simply: "I haven't used it but I would like to know more about it."

A number of utilities have investigated plastic tubing in the past, some only desultorily, and found it wanting. Manufactured gas companies have not taken to it, because, as Mr. Dye points out, "the evidence indicates that this plastic is not resistant to aromatic hydrocarbons such as are present in manufactured gas."

C. L. Kleis of Citizens Gas & Coke Utility, Indianapolis, explains that his company is not using plastic pipe because "we are using a mixture of manufactured gas and natural gas and it has been our experience that plastics cannot withstand some of the compounds in our manufactured gas."

On the other hand, the hesitation on the part of natural gas companies to adopt it on the grounds that it is too brittle or will not withstand low temperatures may be at least partially resolved by Southern California Gas Co.'s findings, as related in Mr. Dye's story. The fact that Denver's mile-high climate has not apparently affected it sufficiently for Mr. Miller to report any adverse effects should lend weight to the temperature findings of SoCal. The type used in Minneapolis, another cold area, has been found to be "stiff and brittle" in the winter, but this has not deterred the company from using it. Its advantages as a nonconductor have obviously overbalanced this objection.

If the survey turned up few companies who are using plastic tubing and are in a position to answer questions of other companies who have had no experience with it, it did prove that interest in the subject has mushroomed. As additional evidence of this interest, both AGA and PCGA have scheduled papers on it for their distribution meetings this month. It is to be hoped that communication among individual companies on the subject will be stimulated by these presentations.

Testing

Four companies are considering making tests of plastic tubing in the foreseeable future, including Washington Gas Light Co., Public Service Electric & Gas Co., Newark, Municipal Gas Department (Long Beach, Calif.), Southern Union Gas Co., Dallas.

W. K. MacMahon of Washington reports that "tests conducted in 1946 indicated the product available at that time became brittle at low temperatures. We therefore considered it hazardous and did not use. However, it is planned to conduct additional tests on presently available plastics, with realization that ground temperature differential in this area is a factor for consideration."

At Public Service Co., where the company has been "quite successful" in pulling soft copper tubing through old steel services, experiments have been carried on in the North Hudson district to find a plastic to replace the hard-to-get copper. Early results showed the only tubing tried did not have the necessary tensile strength to withstand the necessary pulling strain.

Safety in the Regulation of Gas Pressures

By ALLEN D. MacLEAN
Chaplin-Fulton Manufacturing Co.
Pittsburgh

Exclusive

THE practice of safety resolves itself into two main activities; first, those directed to prevent the occurrence of incidents which endanger life and property; and second, those activities designed to minimize the effect of such incidents, if —in spite of all precautions—they occur.

Safety in the control of pressure in gas transmission, distribution, and utilization assumes great importance when it is realized that over-pressure or under-pressure can result in a number of types of accidents. Over-pressure, for instance, can result in a physical failure by bursting of such containing parts as regulator diaphragm cases, meter cases, etc., and in which the physical bursting, without conflagration, can injure a bystander. The gas leaking free after such a physical failure, or from any cause, may be ignited, resulting in fire hazard; or worse, gas can leak until an explosive mixture with air is attained, and then, by some form of ignition, explode. Also, the leaking gas without ignition can injure health through inhaling, particularly manufactured gas with its content of carbon monoxide.

Improper Combustion

Another serious form of danger resulting from over-pressure—sometimes not from extreme over-pressure—is improper combustion of gas. If a burner is subjected to pressures higher than its designed pressure, and an insufficient supply of air is mixed with the burning gas, deadly carbon monoxide is generated. Over-pressure, too, can "lift" pilot lights and extinguish them, so that when a supply of gas to the appliance is turned on automatically, a dangerous stream of unignited gas is flooded into the space around the appliance.

Under-pressure, usually through secondary action, can cause serious difficulties. Ignited burners can go out during a period of low pressure, and on resumption of pressure flood an area with unburned gas. Pilot lights extinguished by low pressure will allow unburned gas to escape when an automatic appliance is turned on later. To be absolutely safe in controlling pressure, its value should at all times be bracketed between a permissible high value and a permissible low value.

In this discussion of safety in pressure control, since so many companies at the present time are exercising all precautions to prevent pressure accidents, but may not be providing all possible means to minimize the effects of unexpected pressure conditions, we will discuss first the means for relieving an unsatisfactory pressure condition.

Safety Valves

The most generally used device against over-pressure is the safety valve. This is a rather simple device and in many instances is a very satisfactory means to protect against excessive pressure on a system. However, safety valves sometimes have some important disadvantages which should be fully recognized whenever they are employed. Simple and practical safety valves are illustrated in *Figs. 1, 2 and 3. Fig. 1* is a dead weight type valve, whose main limitation is the range of relieving pressures. Because of space limitations for weight, its maximum relieving pressure is from 3-7 psig, depending on the size. This type is applicable to all low pressure systems where the usual pressure is less than 1 psig.

Fig. 2 is a spring type safety valve, on which, by the adjustment of various

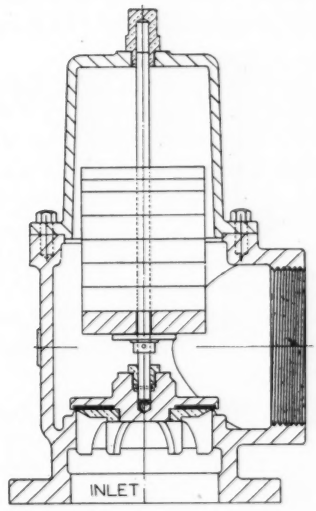


Fig. 1. Deadweight type safety valve.

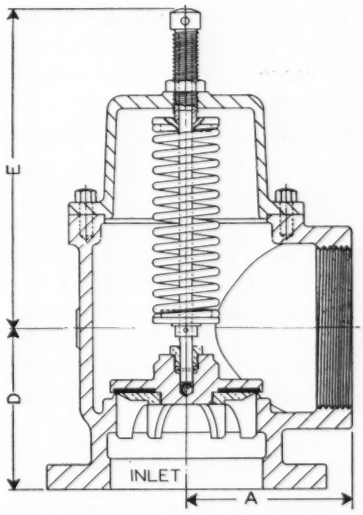


Fig. 2. Spring type safety valve.

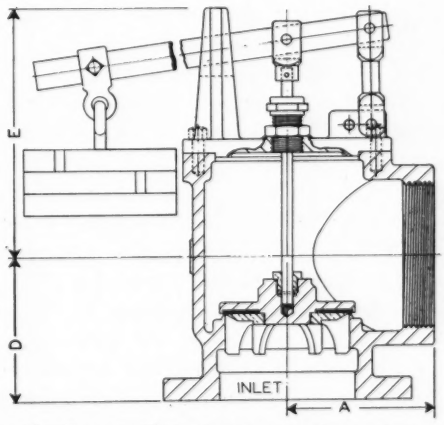


Fig. 3. Lever-weight type safety valve.

springs, the relieving pressure can be extended to about 25 psig. This range then is applicable to normal low pressure distribution systems and medium pressure systems up to 25 psig.

In *Fig. 3*, the use of a lever-weight system permits the extension of the range of pressure protection up to a maximum of 50 lb in some sizes and 120 lb in other sizes.

In comparing these three types, the following facts should be considered:

In the matter of capacity, as we will see later, the dead weight and the lever-weight types are superior to the spring type. This is because the increasing spring compression which accompanies a wider valve opening (to take care of increased discharge volume) requires an appreciable increase in the pressure being relieved.

The lever-weight and spring types are simple to adjust for the relieving pressure, since this can be done externally, but to adjust a dead weight type requires removal of the top cover.

The dead weight type is less susceptible to unauthorized tampering. The lever-weight type is more subject to external interference than the other two; that is, the relieving pressure can be varied by external bodies interfering with the lever.

In the actual performance of safety valves, one important consideration is that the valve should not leak gas at pressures in the normal operating range. To insure this, the valve must be of fairly soft material and so adjusted that it does not crack to allow the gas to escape until the pressure is above the normal maximum operating pressure.

Opening Behavior

Fig. 4 shows the opening behavior of a normal safety valve of the dead weight type. Horizontally we have shown the valve lift in inches, and vertically we have shown the pressure under the safety valve seat. In the lower curve it will be noted that the point P_c, which is the pressure at which the valve first allows gas to pass, is about 1.2 psig. An increase to about 1.45 psig in the pressure being relieved is required without any very great increase of valve opening. This point is indicated by the point P_L. From this point on, however, the valve opens abruptly and a small increase in pressure will cause a valve to open wider and thereby relieve a relatively large amount

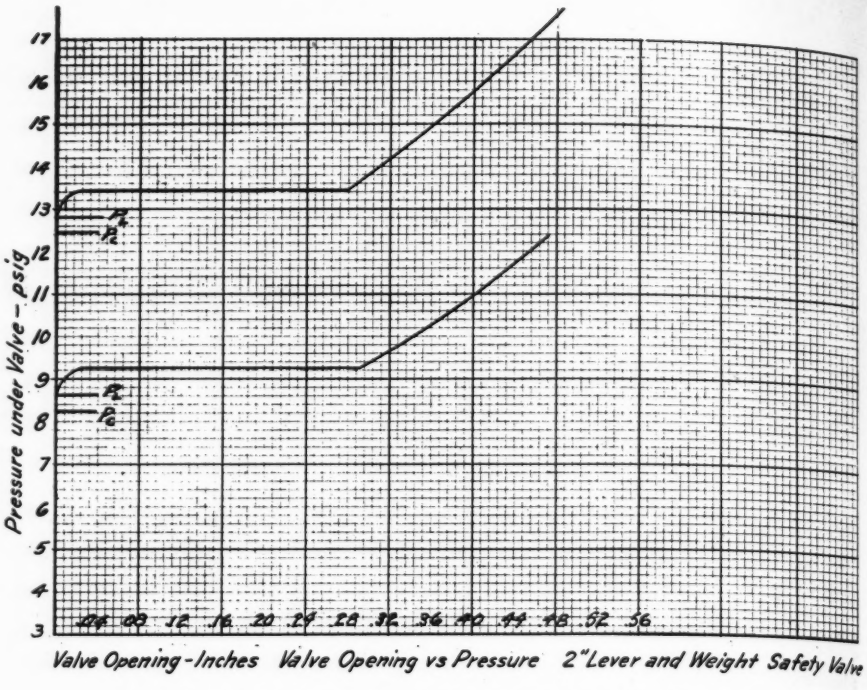


Fig. 4. Operating characteristics of a deadweight type safety valve.

of gas. This relation between the valve opening and pressure varies a little with the design and size but in general follows the pattern as shown in *Fig. 4*.

The discharge ability of safety valves is an important consideration. Like the discharge of gas through any orifice, the general formula for flow is:

$$Q = K \times \sqrt{P_d}$$

where

Q = rate of discharge in cfh of gas at atmospheric pressure.

K = a constant, depending upon the area of discharge exposed when the valve is open and, to a certain extent, upon the shape of the area leading away from the safety valve. This value is experimentally determined or at least based upon results of experimental work.

P_d is the pressure existing just below the seat of the discharge valve and is for all practical purposes the maximum pressure being imposed on a system which is being protected.

An important fact to be noted here is that the opening of the valve — that is, its lift off the seat—is dependent on P_d. An increasing P_d is required to lift the valve to a larger opening, and give a larger factor K. Thus, we have the discharge ability of a valve doubly dependent on P_d; first in determining the size of opening, which influences the value of K and second, in the $\sqrt{P_d}$ part of the formula.

To evaluate the discharge pressure, an assumption must be made as to the relation of the maximum permissible discharge pressure to the pressure P_c, the pressure at which the valve first starts to leak gas on increasing pressure. If conditions of the system are such that the discharge pressure may be allowed to increase to 1.25 times the initial cracking pressure, one valve opening and one discharge rate will prevail. If an increase to 1.5 times the cracking pressure is permissible, then an increased valve opening with an increased pressure will be available, with a resulting greater discharge rate.

As a practical example, let us assume a maximum normal operating pressure of .5 psig. The safety valve is weighted or adjusted to a point where it will initially crack or start to pass gas at about .75 psig. On increasing pressure, if we assume a permissible increase (to open the valve wider) of 25%, then we will go to .75 x 1.25 = .94 psig and will have a set discharge rate. If a somewhat greater increase, say 50%, is permissible to 1.5 x .75 = 1.13 psig, a larger discharge rate will result. Permissible increase in pressure in the system expressed as a percentage of the initial cracking pressure is a function of many factors, one of the principles being the range of pressures involved.

For example, in a low pressure system just described a maximum pressure of 1.13 may not be too serious; but in a medium pressure system of say 20 psig, a 50% increase to 30 psig may not be safe.

However, as explained above, since the permissible increase influences the discharge ability, it must be carefully con-

sidered and used in computing the volume ability of the safety valve.

The value of K in Formula 1 above must be evaluated in order to compute the flow through the safety valve. It is a function of the area through which the escaping gas must flow. This area is

$$\pi D \times LD = \pi LD^2$$

where

D is the diameter of the valve in inches

and

L is the lift of the valve off its seat, expressed as a percentage of the valve diameter.

We can now write

$$K = J \pi LD^2$$

where

J is a constant experimentally determined.

We can also write

$$Q = J \pi LD^2 \sqrt{P_d}.$$

Experimental work has been carried on to evaluate the factor J and *Fig. 5* shows the results of this work for values of P_d corresponding to 1.25 P_c and 1.5 P_c. In the case of the lever-weight type since 1.5 P_c would be a value too high for practical purposes we have eliminated the values corresponding to it in the table. For convenience in computing tables we have shown in *Fig. 5* the value $J\pi L$, so that in computing values of K for any valve diameter D it is only necessary to multiply the table value by D^2.

Using the factors shown in *Fig. 5* and the formula $Q = K\sqrt{P_d} = J\pi LD^2\sqrt{P_4}$, we have computed the capacities shown in *Fig. 6*.

In this table, the normal operating pressure of the system is listed in the extreme left column. The pressure at which the safety valve is adjusted for its initial cracking appears in the next column to the right. The third column is the maximum allowable pressure on the system, here assumed at 1.25 P_c. The next eight columns are capacities in standard cubic feet per hour of .6 gravity gas for the 2-, 3-, 4-, and 6-in. safety valves. Each size is manufactured in two valve diameters. Farther to the right on this table, a permissible maximum pressure of 1.5 P_c is assumed with increased discharge capacities resulting.

Sizing

The actual practice of choosing a safety valve size for a given installation should take into account one important factor — the type of regulator failure which must be relieved. The most common type of failure by which a regulator permits an over-pressure on its discharge side is caused by foreign matter such as small stones, welding cuttings, or dirt getting on the valve seats. If the valves and valve seats are of a hard or metal type, this may cause quite a large opening which the action of the diaphragm cannot close. This will permit a large flow of the excess gas to build up the outlet pressure, particularly at low load hours.

By far the greater number of regulators in distribution work are now of the soft seat type, using synthetic rubber or leather seats, which will to a certain extent imbed hard foreign particles and in many instances, through the power of the diaphragm, limit the flow so that no dangerous pressure increase takes place. In most instances where this soft seat type valve is used, while the regulator cannot completely control the flow, this excess gas flowing is small enough in volume to be taken care of by the safety valve.

Sources of Overpressure

A failure to shut off completely can also result from a soft seat being scarred or having its seating surface otherwise damaged by flowing gas. Sometimes, too, if the valve is not accurately guided a number of seat rings will be made on the surface, crossing one another and causing a high shutoff. In general, overpressure caused from these sources can be satisfactorily relieved by a normal safety valve.

In some regulator designs the connection between a valve stem and diaphragm stem is made so that it can unfasten with a resulting dropping open of the valve, exposing the full area for the gas to flow through. Under certain conditions, external effects on the weight, lever, or other parts can force the valves to their wide open position. A ruptured or badly leaking diaphragm may allow the valves to go to their wide open position. For this latter case, however, the diaphragm can be protected by a small (say ½-in.) safety valve properly located in the control line to the diaphragm. In such an installation, rupture due to overpressure in the diaphragm would not occur.

In any of the types of accident in which the valves of the regulator assume their wide open position, the problem of

$J\pi L$		
	1.25 P_c	1.5 P_c
SPRING TYPE	980	1,520
DEAD WEIGHT TYPE	1,340	1,560
LEVER-WEIGHT TYPE	1,790	

Fig. 5. Table of value J π L for spring dead-weight and lever-weight type safety valve.

Fig. 6. Capacity table of safety valves.

CAPACITY TABLE

Normal Operating Pressure P_o	Initial Relieving Pressure P_c	Maximum Blowing Pressure $P_m = 1.25\ P_c$	Discharge Capacity in cubic feet per hour — .60 Sp. Gr. Gas at atmospheric pressure								Maximum Blowing Pressure $P_m = 1.5\ P_c$							
			2"		3"		4"		6"			2"		3"		4"		6"	
			1½" Valve	1¾" Valve	2½" Valve	3" Valve	3" Valve	4" Valve	4¼" Valve	5½" Valve		1½" Valve	1¾" Valve	2½" Valve	3" Valve	3" Valve	4" Valve	4½" Valve	5½" Valve
DEAD WEIGHT TYPE — 250 DW																			
.5	.75	.94	2,920	4,000	8,140	11,650	11,650	20,800	23,400	39,200	1.13	3,750	5,140	10,400	15,100	13,100	26,600	30,100	50,500
1.0	1.25	1.56	3,770	5,150	10,500	15,100	15,100	26,800	30,200	50,500	1.88	4,850	6,610	13,400	19,500	19,500	34,300	38,000	65,000
2.0	2.50	3.13	5,340	7,300	14,850	21,400	21,400	38,000	42,900	71,600	3.75	6,840	9,250	19,000	27,500	27,500	48,400	54,900	91,900
3.0	3.50	4.37	6,300	8,600	17,500	25,200	25,200	45,000	50,600	84,500	5.25	8,100	11,050	22,400	32,600	32,620	57,300	64,900	108,500
4.0	4.50	5.62	7,150	9,770	.....	.....	28,600	51,000	57,500	96,000	6.75	9,160	12,500	.....	.....	36,900	65,000	75,500	123,000
5.0	6.00	7.50	8,260	11,300	.....	.....	.....	.....	.....	.....	9.00	10,600	14,500	.....	.....	.....	.....	.....	.....
6.0	7.00	8.75	8,940	12,200	.....	.....	.....	.....	.....	.....	10.50	11,200	15,600	.....	.....	.....	.....	.....	.....
7.0	8.00	10.00	9,550	13,000	.....	.....	.....	.....	.....	.....	12.00	12,200	16,700	.....	.....	.....	.....	.....	.....
SPRING TYPE — 250 S																			
1	1.25	1.56	2,760	3,760	.....	10,000	10,000	19,600	22,200	37,000	1.88	4,700	6,360	.....	18,800	18,800	33,500	37,600	63,000
2	2.50	3.13	3,910	5,340	.....	15,600	15,600	27,800	31,400	52,300	3.75	6,620	9,000	.....	26,500	26,500	47,300	53,200	89,000
3	3.50	4.37	4,620	6,300	.....	18,500	18,500	32,800	37,200	62,000	5.25	7,850	10,600	.....	31,400	31,400	56,000	63,000	105,500
5	6.00	7.50	6,050	8,250	.....	24,200	24,200	43,000	48,000	81,000	9.00	10,250	13,900	.....	41,000	41,000	73,200	82,500	138,000
10	11.00	13.70	8,170	11,100	.....	32,700	32,700	58,100	66,000	109,500	16.50	13,900	18,900	.....	55,600	55,600	99,000	111,500	187,000
15	16.50	20.70	10,000	13,700	.....	40,200	40,200	71,500	81,000	135,000	24.8	17,000	23,200	.....	68,100	68,100	121,200	137,000	229,000
20	22.00	27.50	11,600	15,800	.....	46,400	46,400	82,100	93,400	155,000	33.0	19,600	26,700	.....	78,600	78,600	140,000	158,000	264,000
25	27.50	34.40	12,900	17,600	.....	51,800	51,800	92,000	104,000	173,500	41.3	22,000	29,800	.....	88,000	88,000	156,500	176,000	295,000
LEVER AND WEIGHT TYPE — 250 WL																			
10	11	13.7	14,900	20,500	41,500	59,500	59,500	106,000	120,000	200,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	22	27.5	21,100	28,700	58,800	84,500	84,500	150,000	135,100	283,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
30	33	41.2	25,800	35,200	72,600	103,000	103,000	183,500	208,000	346,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
40	44	55.0	29,800	40,600	83,000	119,200	119,200	212,000	240,000	400,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
50	55	68.7	33,300	45,500	92,800	133,400	133,400	237,000	268,000	447,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
60	66	82.5	36,800	49,700	101,800	146,200	146,200	260,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
70	77	96.2	39,600	53,700	110,000	158,000	158,000	281,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
80	88	110.00	42,300	57,500	117,400	169,000	169,000	300,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
90	99	124.00	44,900	61,000	124,900	179,000	179,000	318,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
100	110	137.50	47,200	64,300	131,000	188,000	188,000	336,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
110	121	151.0	49,500	67,400	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
120	132	165.0	51,700	70,500															

relieving gas fast enough to protect the outlet system against serious over-pressure is a rather complicated one. To give full protection, the relieving device must be able to pass, from the maximum allowable pressure on its inlet to atmospheric pressure, the same amount of gas which would pass through the wide open regulator with the existing inlet pressure to an outlet pressure equaling the maximum allowable system pressure. In many cases, under such conditions the size of the safety valve or the number which would be required to give full relief would be prohibitive.

Volume Capacity Boosts

It must be remembered, however, that the volume capacity of the valve to relieve pressure increases as the blowing pressure (i.e., the system pressure) increases. Even if we have a condition where the regulator has fallen wide open and the safety valve, although wide open, cannot handle the volume, as the pressure on the outlet system increases the amount discharged through the regulator decreases, because of lower differential pressure across it, and the capacity of the safety valve increases since the differential pressure across it is larger.

Thus, although a safety valve may be too small to keep the pressure to a desired minimum, it will keep the pressure from rising to anywhere near the inlet pressure. Of course, without a safety valve the outlet pressure would in general arrive at a value equal to the inlet pressure. For any given regulator and any given safety valve used in conjunction with it. the point to which the outlet pressure will rise with the regulator wide open can be computed.

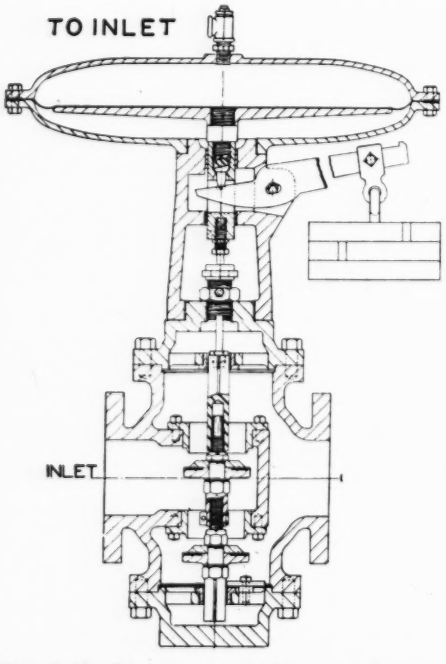


Fig. 8. Back pressure regulator used as a safety valve.

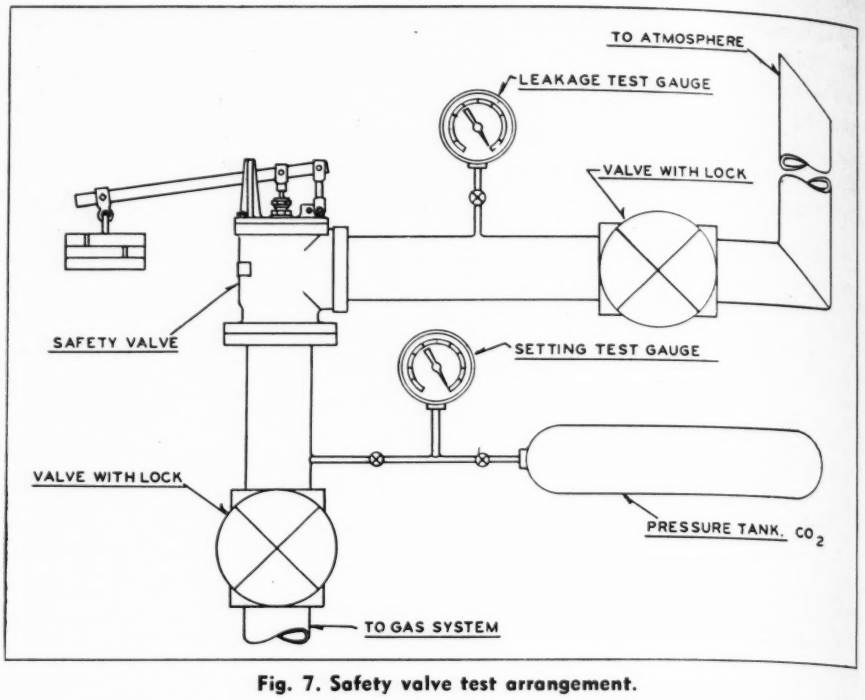


Fig. 7. Safety valve test arrangement.

What Valves Will Do

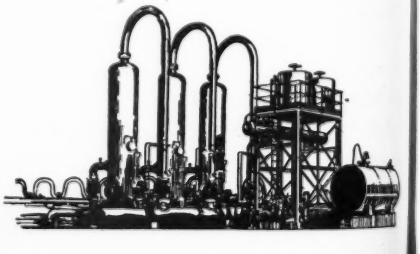
To sum up the matter of safety valve capacities: For the large majority of over-pressure regulator failures which are those resulting from foreign matter on valve seats, or scarred valve seats, a safety valve of the same nominal size as the regulator will relieve the excess gas pressure and prevent the pressure on the system from reaching a dangerous point. For the very exceptional case of a regulator valve going wide open, which occurs when the diaphragm stem and valve stem separate (possible in only a few designs), or the diaphragm breaks, or external force is brought to bear on a lever, a single safety valve of the same nominal size as the regulator will not relieve a sufficient quantity of gas to protect the outlet system. The safety valve will, however, relieve to such an extent that the maximum pressure on the outlet system is considerably below the existing inlet pressure to the regulator.

In the installation of safety valves, certain factors should be incorporated in the installation design. It is obvious that the discharge location from which the blowing gas will escape to atmosphere should be at a safe location. It should not be near any flames or ignition means such as auto exhausts, sparks, etc.; it should be remote from any dwelling or living space. It is not necessary that the safety valve be located at the regulator's immediate outlet, but it can be located at almost any safe downstream point, provided the line perssure loss from the regulator outlet to the relief valve is taken into account.

The piping from the safety valve outlet to atmosphere should be as free of restrictions as possible, with the shortest possible piping.

One factor which should also be considered is the testing of the safety valve. It should be tested at intervals to see that it is not leaking under normal operating conditions and thereby contributing to the unaccounted-for gas. A test should also be made occasionally to see that the valve will blow and is not stuck to its seat.

In arranging for such a test procedure, every precaution should be exercised to see that the valves in the safety valve line are so arranged that they are not left in a closed position and that they cannot be closed by unauthorized persons, or by



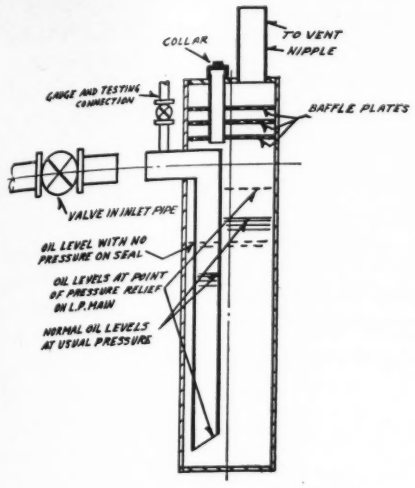

COLLAR
TO VENT NIPPLE
GAUGE AND TESTING CONNECTION
BAFFLE PLATES
VALVE IN INLET PIPE
OIL LEVEL WITH NO PRESSURE ON SEAL
OIL LEVELS AT POINT OF PRESSURE RELIEF ON L.P. MAIN
NORMAL OIL LEVELS AT USUAL PRESSURE

Fig. 9. Oil seal for over-pressure relief.

mistake. Removing the hand wheel or locking the valve in the open position will in general accomplish this.

Fig. 7 shows a suggested safety valve installation. To test a valve for leakage under normal pressure conditions, a gauge, such as a water column, can be connected to the outlet test connection. With the outlet valve closed, any leakage will build up a pressure between the outlet valve and safety valve and immediately show in the water column. Care should be taken to see that after the test is completed the outlet line valve is open and locked open.

To test the safety valve for cracking point (that is, the pressure at which the first leakage occurs on increasing pressure under the valve seat), both the inlet and outlet valves are closed, and the water column or gauge is connected, as in the leakage test, to the outlet connection. To the inlet connection a tee connection is made to a source of controllable pressure such as a small carbon dioxide tank. The opposite side of this tee connection is connected to a suitable gauge. By gradually increasing the pressure from the carbon dioxide tank and watching the outlet water column for flow, the pressure at which cracking first occurs can be read at the inlet and the safety valve adjusted to give the proper initial cracking point. After such a test, both the inlet and outlet valves must be opened and locked open.

Another device for relieving over-pressure, sometimes used where it is desired to have a large capacity relieving device, is the inlet pressure (or as it is sometimes called, back pressure) regulator. Such a device is shown in *Fig.* 8. By connecting the regulator inlet to the pressure to be relieved, and also connecting the diaphragm case to the same pressure, and then connecting the outlet to a safe venting location, any pressure in excess of the setting of the weight will allow gas to pass through the regulator to atmosphere. This type of relief valve has double valves and can be chosen for size to completely relieve the discharge of a regulator whose valves have fallen wide open. While this device is somewhat more costly and larger than the ordinary normal relief valve, it does give the possibility of complete volume relief when required.

In low pressure distribution work, where pressures are normally somewhat less than 8 oz, the oil seal has found wide acceptance over the years. It is larger and more cumbersome than a safety valve, takes up much more space, and is considerably more expensive. Many variations in design have been proposed; the type shown in *Fig.* 9 is typical.

Oil Seal's Advantage

One important advantage of the oil seal is that if the liquid level is maintained, there can be no leakage of gas under normal operating pressures. One disadvantage of the oil seal is that, when it is called upon to blow, there is possibility of loss of liquid through the exhausting line and hence a lower re-sealing pressure after the cause of over-pressure is removed.

In the drawing shown, there are three baffles imposed in the stream of blowing oil and gas. These baffles, having stag-

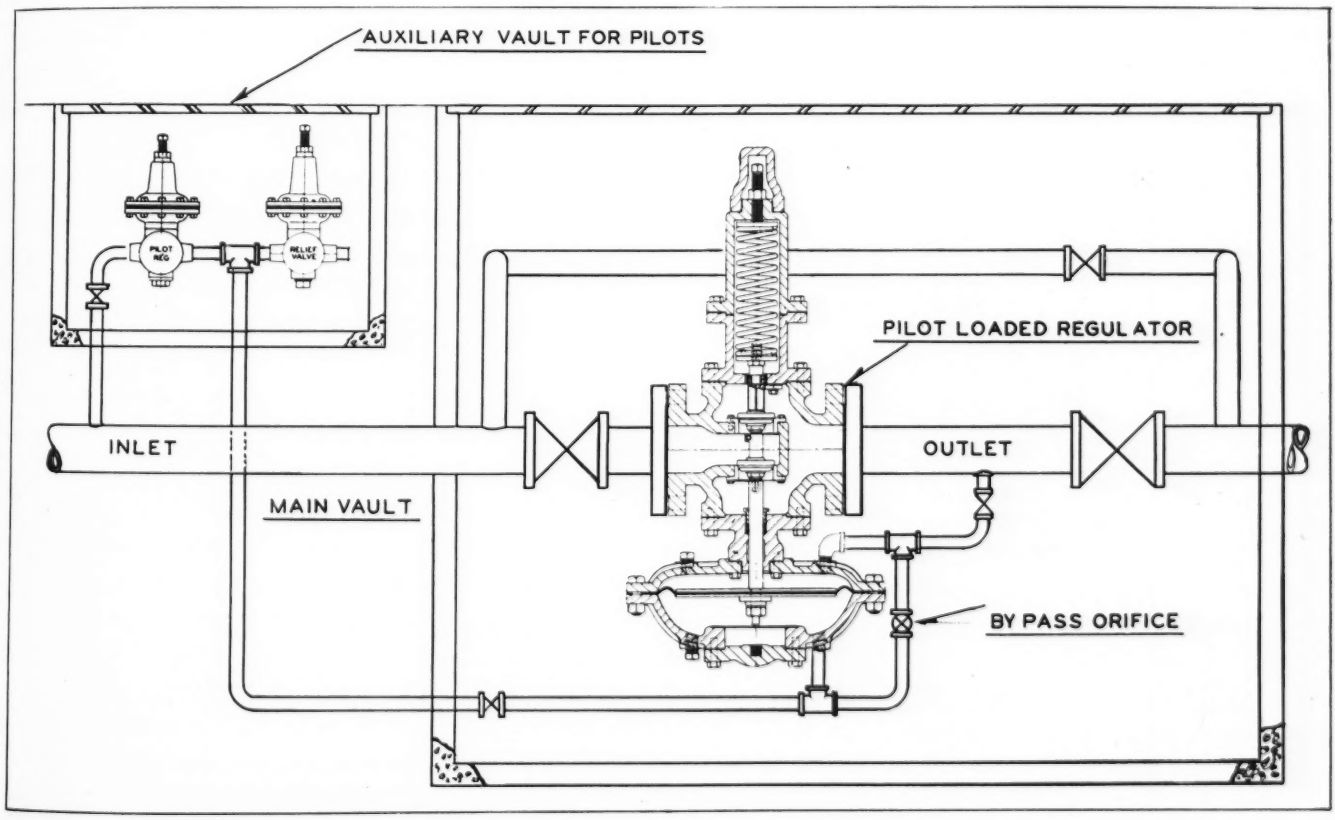


Fig. 10. Pilot regulator system with pilot located at point outside of vault.

gered holes, are intended to divert the oil back into the tank and thus prevent it from being carried off in the gas stream. Baffle devices are not always 100% efficient and occasionally, particularly after a known period of blowing, the oil level should be checked.

In some designs the escaping stream of oil and gas hits baffles which return the oil to a second tank elevated above the main seal and so piped that the oil returns to the main tank. Care should be taken in designing all baffle type devices, that too much pressure loss is not imposed in the flow stream of escaping gas.

Evaporation of the sealing liquid can take place and should be occasionally checked; however, there are available oils, generally in the transformer oil class, which have extremely low evaporation rates. Some companies for economy reasons use water in the seals with a layer of oil on top.

Prevention

Our discussion so far has been on devices to relieve over-pressure, once it has taken place, and to limit the magnitude of this over-pressure. Of extreme importance, of course, is that phase of safety which prevents the occurrence of over-pressure or under-pressure, or at least immediately warns of any tendency and limits the action.

The obvious initial step in this direction is to select pressure control equipment of a high standard of design and workmanship. There are many types of pressure controls, each having certain characteristics in face of certain types of mechanical failure. These are listed in an article appearing in the November 1951 issue of *GAS*, entitled "Selecting A Regulator."

Internal Failures

In this particular article, the types of failure listed concern, in general, the failure of the internal parts of the regulator mechanism. Recently there have been some serious failures resulting from external causes affecting the regulator operation. In a lever-weight regulator, unauthorized tampering may affect pressure, or as recently happened, an explosion may cause the vault or housing around the regulator to so affect the external moving parts that serious over-pressure occurs. It is obvious that this type of external interference with a regulator can be avoided by using a regulator with no external or moving parts.

Many of the pilot controlling or pilot loading types have no external moving parts, and therefore cannot be affected by external forces. It is further possible to locate the pilots themselves at points remote from the regulator or at points especially protected against any external tampering. Such an installation is shown in *Fig. 10*.

Two In Series

One method of safety protection used quite extensively particularly where there is a fairly large pressure reduction from the inlet to the outlet side of the regulator, employs two or more regulators in series. In such a two-stage system, the first regulator can have an outlet pressure which is as low as consistent with the capacity of the second regulator. Thus, failure of the first regulator will only impose an unusually high inlet pressure temporarily on the second regulator, which it should be able to withstand without any appreciable increase in outlet pressure.

Failure of the second regulator will impose at the maximum the outlet pressure of the first regulator on the outlet system. We must, of course, give thought to the possibility of the failure of the two regulators simultaneously. This can occur from some external source affecting both regulators. This probability can be eliminated by placing the two regulators so that they are not in the same location or pit. Simultaneous failure also might occur when some new source of gas carrying excessive dirt is turned in. However, as

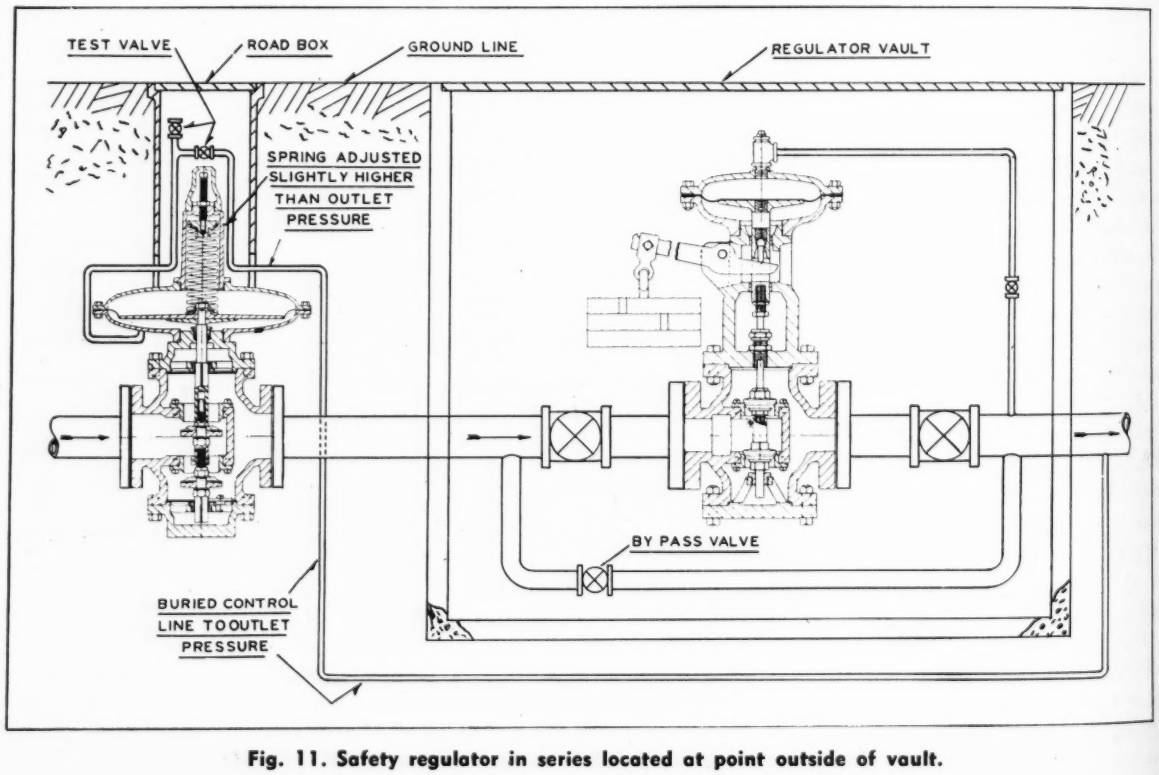


Fig. 11. Safety regulator in series located at point outside of vault.

pointed out above, simultaneous failure is an extremely remote possibility. Series regulators will give a large degree of protection which, on a probability basis, can be justified.

Another Possibility

Another possible safety type of installation is shown in *Fig. 11*. This consists primarily of a regulator installed ahead of the main control regulator and in series with it. This safety regulator can be a simple spring type, since it is not called upon to perform with a high degree of accuracy. It will be noted that the control line for this safety regulator is connected downstream from the main regulator by a line which does not pass through the main regulator vault.

This is done to avoid any effects from explosions or other occurrences within the vault. The spring of the safety regulator is set at a point to operate at a pressure somewhat higher than the normal outlet pressure of the system. Thus, if due to failure of the main regulator, the outlet pressure tends to rise to the setting of the safety regulator, the safety regulator takes over at this slightly elevated pressure and controls the system.

While a safety regulator can be installed in a regulator vault or housing it is possible, since it is called upon to operate only at rare intervals, to completely bury this regulator except for the spring adjustment and test lines. A regular valve street box can be used to protect these parts.

Test Hookup

The safety regulator can be provided with a test hookup, whereby it can be periodically checked for operation. In this test, the valve in the downstream control line, which is just below the road box lid, is closed. Another valve is provided so that a source of high pressure from, say, a carbon dioxide tank, can be applied below the diaphragm of the safety regulator. As this pressure is increased, the valves of the safety regulator will start to close, which will cause the main regulator in the vault to start opening wider. The pressure at which this occurs can be noted at a gauge at the carbon dioxide tank, and is the value to which the outlet pressure would build in case of failure of the main regulator before the safety regulator came into operation.

In some installations, this test can be carried to a point where the final shutoff point of the safety regulator can be determined. On completing this test, it must be certain that the pressure application valve is closed and the control line valve is left open.

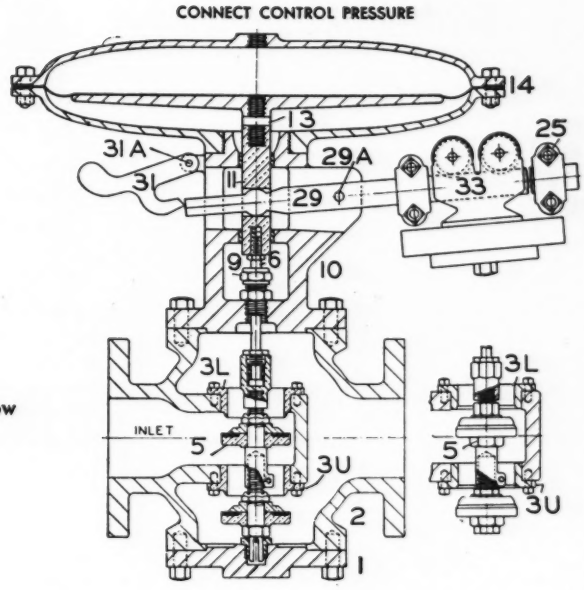


Fig. 12. Automatic low pressure cutoff valve.

The propriety of burying a regulator without a protecting vault may be questioned by some; however, this practice is followed to an increasing extent. When it is remembered that many gate valves and similar devices are buried, this does not seem too extreme. Furthermore, the regulator normally is wide open and only called upon to operate at long intervals and is not subject to deterioration. It has no external moving parts and no stuffing boxes. The new synthetic rubber valve discs have extremely long lives, particularly when not subject to operation. And lastly, means of testing and adjusting the safety regulator through the road box is always available.

Claims

In order to insure against over-pressure there are many alarm devices which can be used. Gauges with electric contacts can be installed at strategic locations and, over leased telephone lines, sound over-pressure or under-pressure alarms at some central point, such as a dispatcher's or superintendent's office. However, if the expense of telephone lines is to be incurred, a complete remote pressure indicating or recording system could be used without greatly increased expense, including the alarm devices.

The dangers of under-pressure are mainly those resulting from the resumption of normal pressure after a burner or pilot has gone out due to the under-pressure. Many gas-burning devices using pilots have incorporated in them safety units which prevent the gas from flowing once the pilot has been extinguished. Manual action is required to resume service.

A widely used under-pressure device is shown in *Fig. 12*. This is simply a safety device and is not for the purpose of regulating pressure. It is used primarily in industrial gas installations.

Piped To Top

In this installation the outlet pressure is piped to the top of the diaphragm. This diahpragm pressure forces the valves open and balances a lever and weight arrangement. If the outlet pressure goes to a low point so that the lever beam slants downward to the right, a weight (33) moves to the right and increases the leverage closing the valves. A latch (31) moves by gravity into a position which locks the lever in a closed position and the flow of gas is stopped. Manual resetting is required before gas flow can be resumed.

We have covered here a few of the protective devices brought into play in case of pressure troubles and have enumerated some of the methods which can be used to insure against bad pressure conditions. The weighing of the cost of these devices against the probability of their being valuable in protecting life and property is an individual problem for each situation. In view of the wider acceptance of gas as a fuel and the increasing complexity of gas systems, the scale seems to be moving in favor of more safety devices and better safety practices. A good history in the matter of safety, which the gas industry as a whole enjoys, can only be protected or improved by continual effort in that direction.

Distribution - Corrosion - Motor Vehicles Issue

Corrosion Control TRUCKS

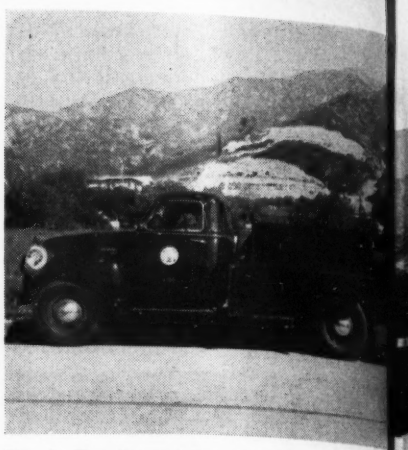


Fig. 1. Truck used for cathodic protection work outside metropolitan Los Angeles.

By F. O. WATERS
Southern California Gas Co.
Los Angeles

SUITABLE instruments and equipment are as essential in corrosion study and investigation as a knowledge of the fundamentals of the science itself. In field work, it is necessary that the instruments arrive in good condition and that they be always available and ready for use.

To meet these requirements, a carefully designed truck is a must.

Southern California Gas Co. is using a truck for corrosion work that has proved capable of carrying the needed equipment into rough terrain without damaging instruments. A special body, to be described later, is mounted on a 1-ton truck chassis. Any standard make chassis is satisfactory, although it must have a 4-speed transmission and 17 x 7.50, 8-ply tires in order to be able to traverse the desert and mountain terrain. The truck's value is diminished if it can't follow the pipeline to remote places.

The type of truck used for cathodic protection work in areas outside of metropolitan Los Angeles is shown in *Fig. 1*. The body is 96 in. long by 72 in. wide, and when it is mounted on a 137-in. wheelbase chassis there is ample room for a spare tire and water canteen between the cab and the body. The body is constructed of sheet steel, spot welded and riveted.

In *Fig. 1*, the left side is shown with compartment doors open. The compartments on this side were designed to carry the equipment used most infrequently, such as batteries, tool box, first aid kit, employee's luggage, etc. These compartments are not lined with shock absorbing material. However, the lower rear compartment is lined with lead and has ample room for three storage batteries.

For safety purposes, the instruments and the most frequently used equipment are located on the right side, as shown in *Figs. 2* and *3*. Whenever possible, traffic is routed to the left of the truck. The instrument compartments are lined on four sides with rubber, and in the six years that this type truck has been used there has been no damage to instruments resulting from their transportation. Although the photos show the arrangement for storage of the telephone set, pipe locator, potentiometer, soil meter, and recording voltmeter, it is possible to carry other types of instruments in these compartments.

The top front compartment has two sliding drawers for such things as battery clips, lugs, and bolts. Immediately above the drawers are stored various sizes of resistance wires and lead wires. The lower front compartment extends the width of the body and is for long tools such as bars, shovels, and sledges. The door of the top rear compartment is used for the work table during tests. When the truck is moving from one location to another, the instrument in use is usually carried in this compartment.

Hand Tool Compartment

Immediately below is the compartment for hand tools. While it is a convenient place for such equipment, difficulty has been encountered from jarring of the tools onto the compartment floor when in rough terrain. Some smaller tools have been lost en route. It has been necessary to shift the tools from the original arrangement and to design special clips for securing them to the boards. The arrangement shown in the close-up of *Fig. 3* appears to be satisfactory, and the number of lost tools has decreased since adoption of this arrangement.

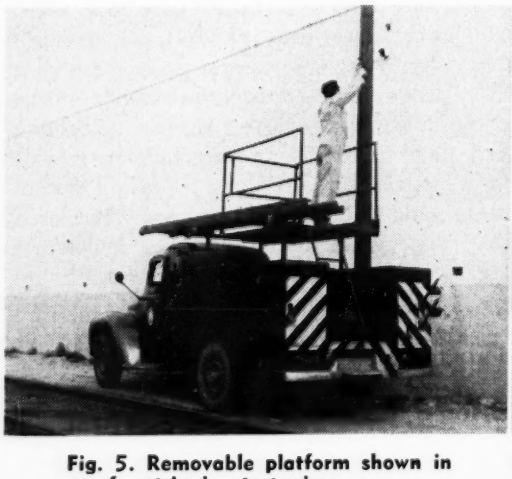


Fig. 5. Removable platform shown in use for stringing test wires.

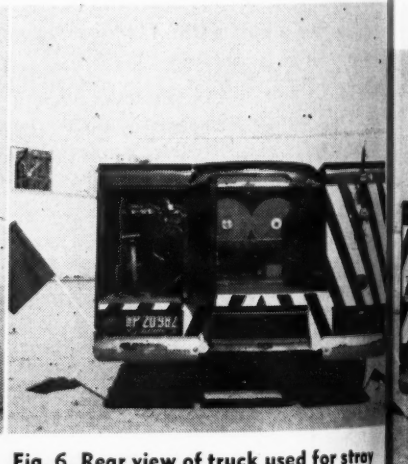


Fig. 6. Rear view of truck used for stray current investigation.

Fig. 2. Rubber-lined instrument compartments located on right side of truck.

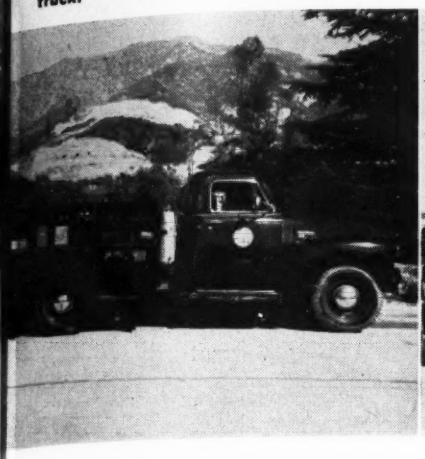


Fig. 3. Close-up of compartments and tool arrangement.

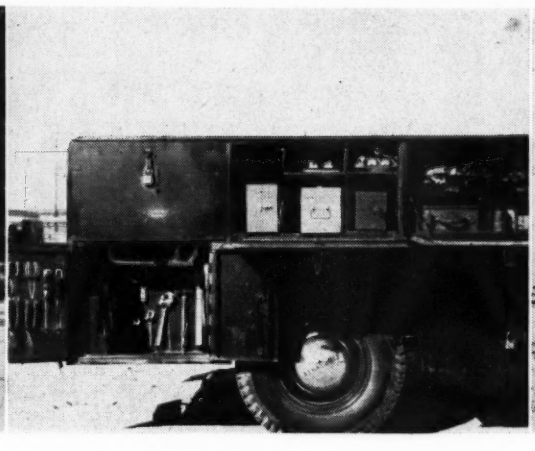


Fig. 4. Truck used in street railway stray current investigations.

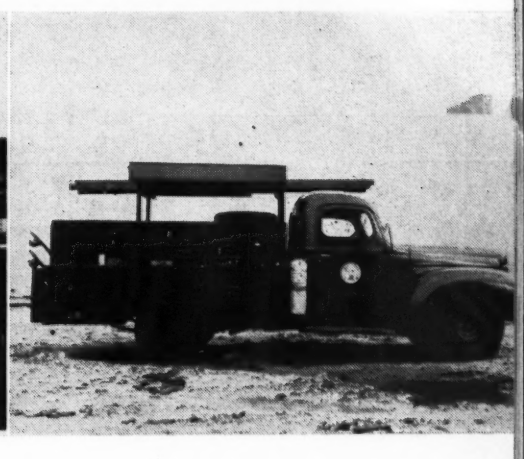


Fig. 4 shows the right side of a truck that is used in street railway stray current investigations. It differs from the other in that the compartments on the right side carry eight recording voltmeters, and the indicating instruments have been moved to the left side, thus eliminating the luggage compartment.

Stringing Test Wires

A platform has been added for use in stringing test wires in elevated positions on poles or trees for 24-hour pipeline potential gradient measurements. The platform can be removed when it is not in use. *Fig. 5* shows the platform in use, with the protective railing up. A ladder is also carried for those places where the platform cannot be used.

Fig. 6 is a rear view of one such truck, shown with the compartments open. The white stripes are luminous for safety during night driving. The left compartment carries the distance measuring wheel, traffic barricades and vault cover lifters. The barricades are arranged so they can be removed from the trucks rapidly. The speed with which one man can remove these barricades and place them to direct traffic has contributed greatly to the safety of our field crews.

The wire used for potential gradient measurements is carried in the center compartment. Insulated 18-gauge stranded wire is used on three 2500-ft reels and one 1500-ft reel in each cathodic protection truck. The fish reels shown at the right are used to make connections between the instruments and the copper-copper sulfate electrode and the pipeline. Each reel carries approximately 150 ft of 22-gauge neoprene insulated wire.

The method of reeling out wire from the large reels is shown in *Fig. 7*. The reel is secured to the truck by means of a clamp and thumb screw. In cooperation with our safety department, we have developed a method whereby this operation can be carried out in city streets without particular hazard.

Figs. 8 and *9* show the compartment doors being used as work tables.

Advantages

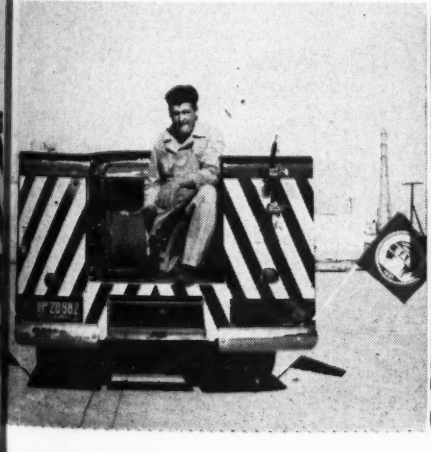
1. All equipment necessary for a survey can be carried. There is ample room to carry an assortment of small items such as nuts and bolts that are not used every day, but which nevertheless are necessary for many unforeseeable uses.
2. The truck handles well in traffic and will go most places where it is required.
3. The compartments provide maximum protection for sensitive intsruments and are conveniently arranged. When the truck is used properly, it proxides maximum safety for personnel.

Disadvantages

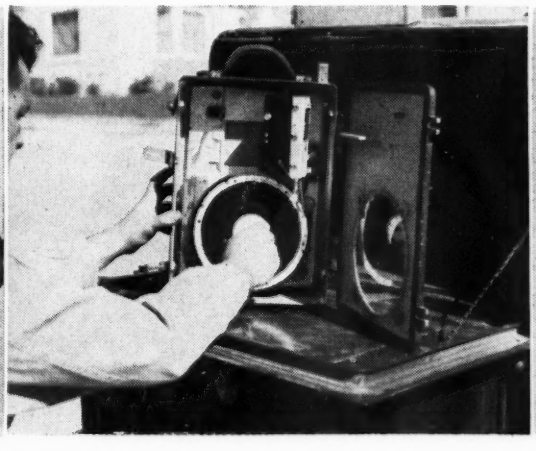
1. The body is made of sheet steel and when fully loaded, including personnel, is close to the maximum weight for the tires. Cost of construction prohibits the use of aluminum.
2. Early difficulty was encountered in water proofing some compartments, including those used for stowing wire reels, hand tools, and shovels; but no instruments have been damaged and it appears that the difficulty has been overcome in the later models.

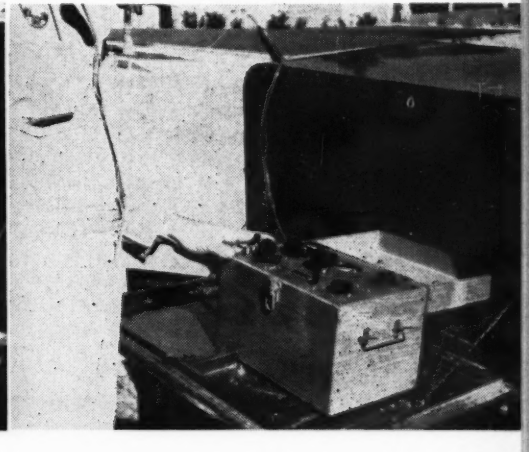
Presented at the PCGA technical services conference in Fresno, Calif., March 5-6.

Fig. 7. Method of reeling out wire.



Figs. 8 and 9. Compartment doors being used as work tables.





Distribution - Corrosion - Motor Vehicles Issue

Magnesium Ribbon Anode

• Report on its development and performance characteristics

By H. A. ROBINSON

THE magnesium ribbon anode (Galvo-line[1]) introduced by Dow Chemical Co. some three years ago, represents a considerable departure from conventional galvanic anode types and opens up intriguing new possibilities for galvanic anode applications in the field of cathodic protection. Deliberately designed to permit new methods of installation and to provide performance characteristics hitherto unavailable from galvanic anodes, the magnesium ribbon anode has now been on trial for some three to four years. The purpose of this article is to review briefly the reasons leading up to its development, to describe the anode and its performance under various use conditions, and to discuss the results obtained in some typical installations.

Exclusive

Development of the ribbon anode was motivated chiefly by the desire to get more economical performance from magnesium galvanic anodes in soils or waters of high resistivity and to more fully exploit the possibilities for rapid, mechanized installation of anode metal. In addition, the flexible, cored ribbon design offered better distribution and more efficient utilization of the protective current plus a considerable simplification of the installation due to the reduced number of electrical connections between the anode and the structure being protected. In the broadest sense it represents an effort to more fully develop certain latent advantages of the magnesium galvanic anode, to extend the scope of its application, and to provide the corrosion engineer with an additional tool for corrosion mitigation work.

The conventional cast anode is an economical and dependable source of current for cathodic protection in soils and waters of comparatively low electrolytic resistivity. Under these circumstances, current flows are usually ample, or can readily be adjusted, and anode life falls within a practical range (5 to 15 years) for most applications. At elevated soil resistivities the problem of getting current output of a practical magnitude appears. As the electrolyte resisitivity increases, a point is eventually reached where the current output per pound of installed metal becomes unattractively low, cost-wise.

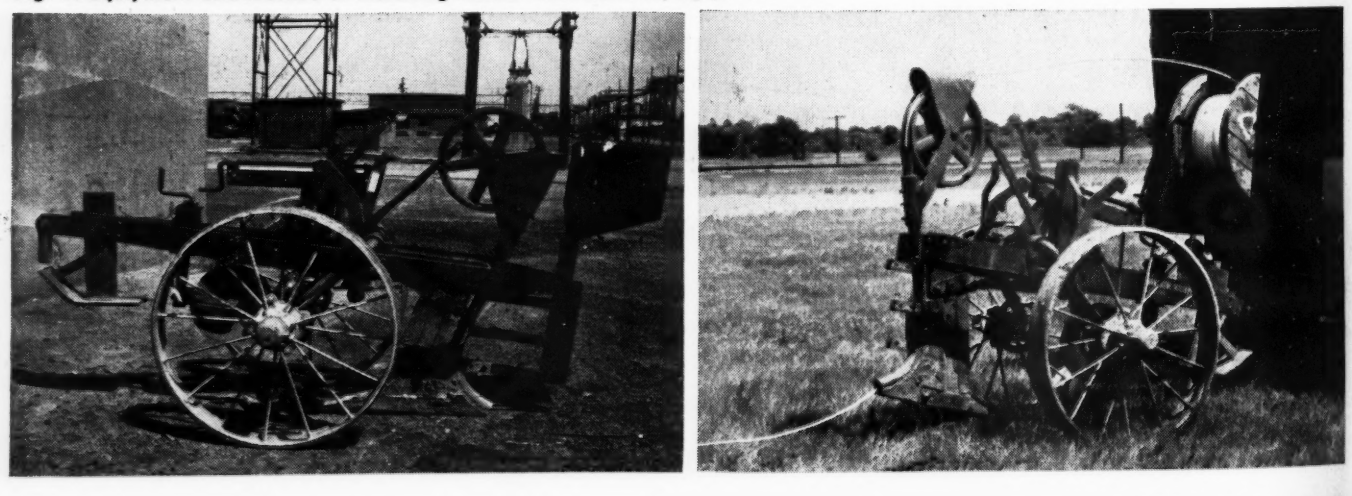
To be sure, the lower current flows are attended by increased anode life, amounting at the higher electrolyte resistivities to 15 to 30 years or more. In isolated cases, installation life of this order is acceptable, but for the most part it is distinctly unwieldy and there are few installation circumstances which will tolerate it when the projected service life of the structure is considered together with the capital investment needed to provide an installation of such extended life.

Because the nature of the application is usually the controlling factor, a definite resistivity "ceiling" for galvanic anodes is difficult to establish except in a general way. In the resistivity bracket be-

[1]Registered U.S. Patent Office, Dow Chemical Co.

Mr. Robinson is assistant director of laboratory development for the metallurgical laboratories of Dow Chemical Co., Midland, Mich.

Fig. 1. Equipment and method of installing ribbon with cable laying plow.



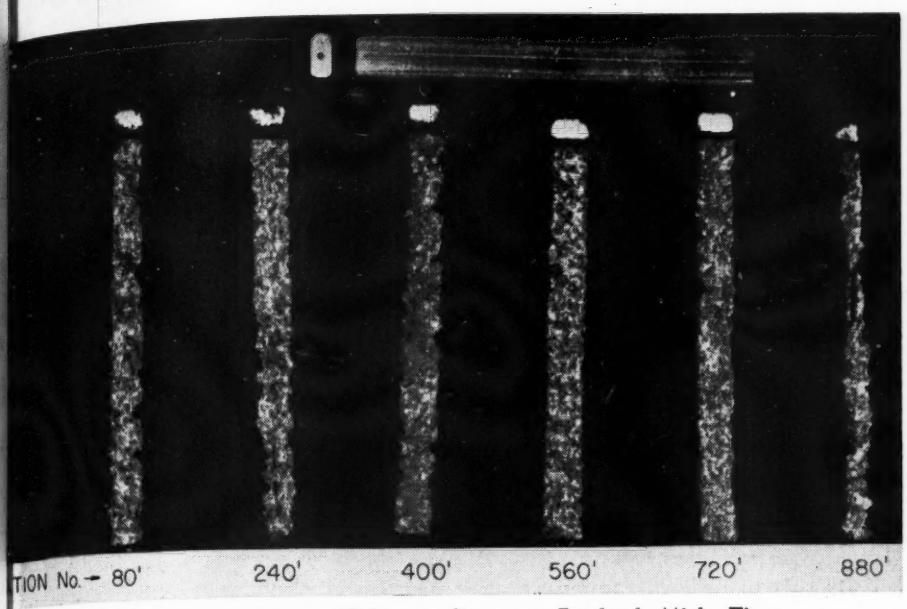


Fig. 2. Ribbon removed from 10-in. gas line near Freeland, Mich. Time installed: 4.2 years.

tween 25 and 2500 ohm-cm, cast magnesium anodes afford current flows of a practical size and permit installations to be designed for a life of 2 to 10 years. With further increase in resistivity, the current output per anode begins to fall below 0.1 amperes and the scope of usefulness becomes increasingly restricted to situations where a small current flow will suffice. At resistivities of 5-6000 ohm-cm, current flows have fallen to 30-40 milliamperes per anode, anode life has become excessively long, and a practical limit of usefulness is essentially reached.

Despite these limitations on galvanic anode performance, the corrosion processes on buried or submerged metals appear to recognize no such resistivity barrier. Numerous instances of pipeline corrosion in the 2500-10,000 ohm-cm resistivity bracket can be cited, and cases of underground corrosion involving soils of 50,000-100,000 ohm-cm resistivity have been reported. The attack on galvanized iron water heaters is most severe in poorly mineralized waters having resistivities of 15,000-25,000 ohm-cm.

Various approaches to the problem of getting better performance from galvanic anodes in high resistivity media have been considered. Extension of the practice of surrounding the anode with a highly conductive backfill would appear to offer promise but in earth of high resistivity an impractically large volume of backfill must be used to get a useful reduction in anode-to-earth resistance. The use of more anodic metals has been suggested but metals lying above magnesium in the electromotive series have proven to be so active that the efficiency of utilization is very poor.

Reducing the size of the cast magnesium anode and distributing it more extensively offers an apparent solution to the problem and, to a limited extent, anodes of ½ ampere-year capacity or smaller are indicated for unusual underground conditions and certain special applications. Indefinite extension of this approach encounters two major obstacles. The small anodes are more expensive to cast and any very extensive distribution of such anodes would greatly increase the installation cost (per pound of metal) if conventional methods of installation were practiced.

The cored, magnesium ribbon anode represents still another approach to the problem of getting economical protection from galvanic anodes in corrosive media of intermediate to high electrolytic resistivity. The conception leading up to the experimental work on magnesium ribbon anodes was simply that of providing an anode which would have minimum resistance to earth and yet be readily adaptable to mechanical methods of underground installation.

Performance-wise the installed ribbon behaves like a system of small, individual anodes, extremely well distributed, the important difference being that it is physically one continuous, flexible unit, cored over its entire length. This leads to notable advantages in practice.

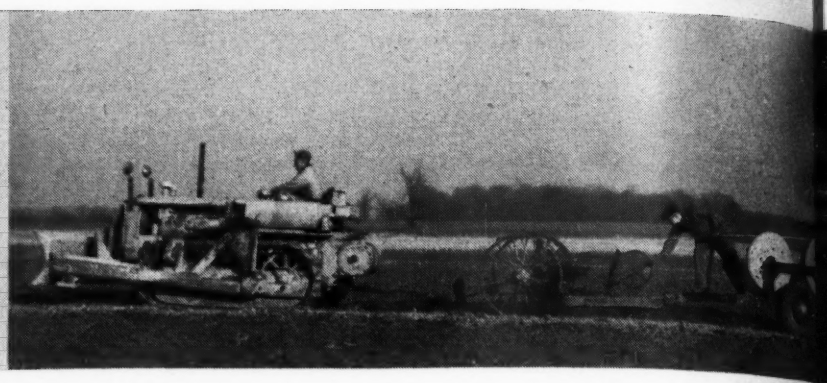
The ribbon anode is formable enough to permit storage in coils or on reels and, for the protection of underground structures, it can be installed mechanically and continuously by means of a wire laying plow *(Fig. 1)* drawn by a tractor or heavy-duty truck, and fed from a reel of ribbon mounted on the truck or an auxiliary trailer. These properties also facilitate forming of the ribbon into such special configurations, e.g., helical, pancake or hairpin coils, as may be needed where the interior surfaces of tanks, large pipes, condensers and the like are to be protected.

The number of electrical connections between the anode and the structure being protected is reduced to a minimum. Since the core wire is in contact with each and every incremental length of anode, the ribbon serves as its own collector wire and much of the wiring normal to the conventional anode installation is eliminated. Given reasonably uniform corrosion of the anode ribbon and relatively light current drains (1-3 ma. per running foot), connections made at intervals of 500-1000 ft should be adequate.

A high degree of distribution of the anode metal is cheaply and easily effected, particularly on line structures such as buried pipe. This should result in exceptionally efficient distribution and utilization of the protective current with

TABLE 1. Typical Composition of Purified Magnesium (Mg-1)

Component—	Al	Ca	Cu	Fe	Mn	Ni	Pb	Si	Sn	Zn	Other
Per Cent—	.01	<.01	.001	.002	.05	<.001	<.001	<.001	<.01	<.001	0.1



Figs. 3 and 4. Plow and trailer pulled by tractor.

an attendant reduction in current requirements.

Experimental work disclosed certain major deficiencies in the design of the early ribbon anodes, and the changes outlined below were made to correct them:

1. In order to jump anode life into a more practical range for general use, the anode cross section was increased from 3/16 in. x ¾ in. to ⅜ in. x ¾ in. This provided a more symmetrical cross section with less chance for premature core wire exposure, and gave a product with a net magnesium weight of 0.20 lb/ft (0.22 lb with core wire). The design basis was that of providing 1 milliampere per foot for ten years at 40-45% anode efficiency, i.e., 80-90 ampere-hours per foot. This entailed some increase in ribbon stiffness but not enough to give difficulty with installation. It also resulted in approximately halving the current output per pound of installed metal but still left the ribbon anode with a two- to three-fold advantage over cast anodes in this respect.

2. A No. 13 gauge, soft iron core wire was substituted for the magnesium alloy core previously used. This gave more stable and dependable coring, and while it increased the chance for galvanic losses in the event of core exposure, the opportunity for exposure had been reduced by the increase in anode cross section.

3. Considerations of cast anode performance pointed up the desirability of being able to use the ribbon anode at resistivity levels as low as 2500 ohm-cm, but the early ribbon tests and previous experience with cell magnesium in cast anodes indicated that its resistivity threshold[2] was usually too high (5000 + ohm-cm) to afford consistently efficient operation at the lower resistivity levels. In view of this, a purified magnesium (Mg-1), prepared by removing the iron from pure commercial Mg, was also placed on field test. This material has the typical composition shown in *Table 1.*

In laboratory tests it has consistently shown more efficient performance than cell Mg, such that efficiencies of the order of 35-50% would be expected under field conditions. It has the additional advantage of being about 0.1 volt more anodic than pure commercial Mg and about 0.2 volts more anodic than the Mg-6% Al-3%Zn alloy used in cast anodes.

Additional underground field tests were undertaken to determine the value of the modifications described above. The results of these, together with experience data from other types of applications, are described in the sections which follow.

Underground Application

Case I. A 1000-ft length of ⅜-in. x ¾-in. cell Mg ribbon was installed to supplement the output of 25 17-lb cast anodes previously installed to protect a 1000-ft span of bare 10-in. gas main near Midland, Mich. The ribbon was buried at a depth of 18 to 20 ft, parallel to the pipe and some 10 to 15 ft to one side of the line.

Owing to the wet, marshy nature of the site, the cable plow was drawn by a winch line from a Dodge Power Wagon. The soil encountered ranged from sandy loam to heavy clay, and soil resistivity varied from 2000 to 7000 ohm-cm (5-ft pin spacing). Connections to the ribbon were made at two points, 300 ft in from each end, and current flow was metered with 0.1 ohm shunts. The ribbon anode and cast anode installation operated in parallel at all times.

TABLE 2. Weight Loss
(In Service 1540 Days)

Station No.	% Weight Loss	% Weight Loss/Yr
80′	60	14
240′	57	13.5
400′	52	12
560′	35	8
720′	40	9.5
880′	79	19
Average	54	13

Over the 4½-year period elapsed since installation, the 220-lb ribbon installation has provided an average current flow equal to that of the 425-lb cast anode installation, although the latter had the advantage of being situated in subsoil of substantially lower resistivity. Current output from the ribbon anode has averaged about 1.3 amp (range 0.5 to 2.0 amp) and after 4½ years of operation still matches that of the cast anode installation. Variations in ribbon current flow have been no greater than for the cast anode installation, the major contrast being that the two installations respond differently to seasonal changes as might be expected due to the difference in depth of anode burial.

Six 1-in. sample sections of ribbon, removed after 4.2 years of operation, show a degree of consumption ranging from 35-80% and averaging about 54%. These data are given in *Table 2,* and the condition of the ribbon samples removed is illustrated in *Fig. 2.*

If the sampling described above is representative, an overall effective anode life of some six to seven years is indicated with some sections of ribbon remaining effective for even longer periods. Anode efficiency for this installation is estimated at about 40% based upon an average current flow of 1.3 milliamperes per foot and an average weight loss of about 13% per year. The installation is of interest principally for the comparison of cast anode versus ribbon performance.

Case II. A large-scale test installation of Galvo-line was begun in December of 1948 when approximately 45,000 ft of ⅜-in. x ¾-in. Mg-1 ribbon was installed on four separated sections (totaling 22,500 ft) of a 10¾-in. bare gas main approximately 60 miles long. This

[2]Resistivity at which local galvanic corrosion rate begins to rise rapidly.

particular installation has already been described in detail by T. W. O'Brien[3] and will only be summarized here.

Soil resistivity at the installation sites ranged from 2000 to 7000 ohm-cm during wet seasons to as much as 15,000 to 20,000 ohm-cm under dry season conditions. Prior to protection, the leak frequency for the "hot" sections averaged 3.75 leaks per mile per year as compared with a frequency of about 0.93 for the balance of the line.

Ribbon was plowed to a depth of 18 to 20 in. and some 2 to 5 ft from the pipe on both sides of the line using a Killefer plow serviced by a tandem trailer carrying six 1000-ft reels of Galvo-line, Plow and trailer were pulled by a TD-4 Caterpillar tractor as illustrated in *Figs. 3* and *4*. Actual plowing-in time was 15 hours for a rate of 3000 ft of ribbon per hour. This is equivalent to a rate of 600 lb of Mg or 35 17-lb cast anodes per hour. Connections to the pipe were made at about 500-ft intervals through 0.01 ohm metering shunts, connection to the ribbon being made as shown in *Fig. 5*. The overall cost of the installation amounted to 20 cents per foot of ribbon or 40 cents per foot of pipe since a double ribbon installation was used.

When last reported[3] the installation had been in service for 15 to 16 months and data covering only 11 to 12 months of service life were available. Since then, the behavior of the installation has been followed carefully and performance data for some 34 months of service are now available.

In general, the total current flow has been well maintained at 35 $\pm$ 10 amp (0.8 ma. per foot of ribbon), and the P/S potential has been held well above —0.85 volts ($Cu/CuSo_4$ reference) except for several months of very dry weather in the summer and fall of 1949 during which some sections of the line dropped below protective potential.

The average current density on the pipe has ranged from 0.4-0.7 milliamperes per sq ft, a remarkably low density in view of the P/S potentials established. *Fig. 6* illustrates the trend of current density, P/S potential and total current over the 34-month period for which data are now available.

Initially, some concern was felt for the protection of a wooded section, some 650 ft in length, through which the ribbon could not be plowed due to the presence of large rocks and roots. When the first post-protection surveys were made, pipe in this section was found to be at or above protective potential, indicating an unexpectedly high throw of current from the adjacent ribbon on either side.

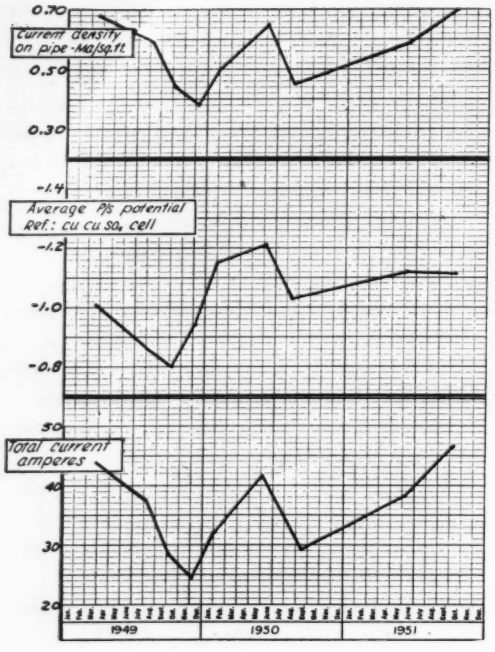
Since failure to bond over the couplings in the affected area could have produced falsely high potentials, these were checked and found to be adequately bonded, indicating the throw of current to be real. These data suggest that comparatively large gaps can exist in the ribbon installation without jeopardizing protection of the pipe in the gap. A typical P/S potential survey of the entire span of ribbon-protected pipe is shown in *Fig. 7*.

Leak frequency over the protected sections fell to 0.75 (leaks/mile/year) in 1949, despite a rise in frequency (to 1.8) over the balance of the line, and since 1949 no leaks have been reported on the Galvo-line protected sections. The complete leak record for the line and the affected sections is given in *Table 3*.

One-foot test sections of ribbon were removed from the installation at the end of 15 and 29 months, respectively, for purposes of determining the rate of anode consumption. The first set of nine samples was removed at random and the

[3]Bulletin DMC-50-7. American Gas Assn. Operating Section, April 1950.

Fig. 5. Method of making connection to ribbon.



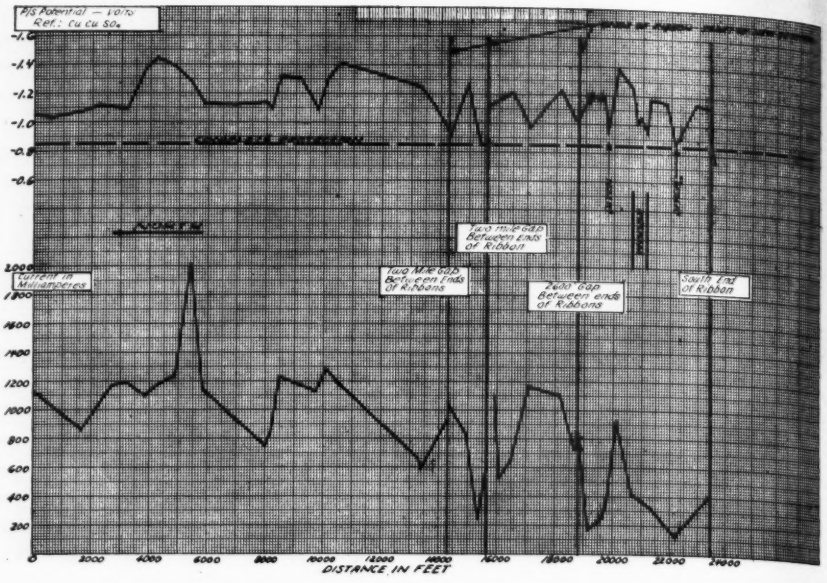

P/S Potential — Volts Ref.: Cu cu SO4
Current in Milliamperes
Two Mg-Rib Between Ends of Ribbon
Two Mg-Rib Between Ends of Ribbons
Zero Gap Between ends of Ribbons
South End of Ribbon
DISTANCE IN FEET

Fig. 6. (Left) Test data on 22,500 ft of bare 10¾-in. ribbon-protected line over 34-month period.

Fig. 7. (Above) Typical data from pipe-to-soil potential survey of same line.

weight losses observed indicated an anode life ranging from 7 to 20 years. The second set of six samples (29 months) was taken with an eye to the effect of soil resistivity. The data obtained from the latter samples are shown in *Table 4*.

Since both the 15- and 29-month spot samplings indicated an effective ribbon life well in excess of 10 years, several sections of ribbon, each about 100 ft in length, were removed at the end of 34 months to check the condition of the ribbon over an extended length. The four sections removed showed weight losses corresponding to consumption rates of 7.2, 11, 9.6, and 6.1% per year, again indicating an effective life of ten years or more. The corrosion attack was comparatively uniform and definitely an improvement over that exhibited by the cell Mg ribbon of Case I. In no instance was exposure of the core wire observed. *Figs. 8* and *9* illustrate the condition of the ribbon after some 34 months of service.

The above data demonstrate the ability of the ribbon anode to protect bare steel pipe of relatively large diameter and yet afford an installation life comparable to that of cast anodes in soils of lower resistivity.

The cost of this installation (40 cents/ft of pipe) compares favorably with the estimated cost ($1 to $3/ft) of reconditioning the affected pipe sections, reconditioning being the principal alternative in this case. It also compares favorably with the estimated cost (60-80 cents/ft) of protecting the above line with 17-lb cast anodes.

Fresh Water Applications

Structures exposed to attack by fresh waters of high resistivity frequently pose galvanic protection problems similar to those encountered in soils of poor conductivity. *Fig. 10* illustrates the use of the ribbon anode to handle one such problem. In this instance the application required that a large, black iron water heater of 2000-gal capacity be protected against attack by hot, fresh water of 7000 to 9000 ohm-cm resistivity. The tank in question measured 5 ft in diameter by 14 ft long, was equipped with copper heating tubes, and had a rated heating capacity of 1200 gph at 100° F rise. The water being processed contained 60-70 ppm T.D.S., had a hardness of 50 ppm ($CaCO_3$) and a pH of about 10.

Current requirements for protection were estimated at 2.5-3.0 ma/sq ft for an overall current flow of 650-750 milliamperes. Since neither cast anodes nor extruded rod of the type used in domestic water heaters would provide the required current in an installation of practical proportions, 300 ft (65 lb) of the ⅜-in. x ¾-in. Mg-1 ribbon were spiralled into the tank to give a single, continuous, helical coil of ribbon terminating in a pancake coil at the ends.

The ribbon was spaced on approximately 6-in. centers about 12 in. from the tank wall and the entire coil was suspended from a pipe support extending the full length of tank about 12 in. below the top. The connection between tank and ribbon was brought outside the tank through an ordinary spark plug so as to permit control of current flow if desired.

Installation was made in December 1947 and the tank was reopened for inspection in September 1951, or about four years later. No evidence of corrosion attack could be observed and no red water formation had been noted in the interval between installation and inspection. The tank walls were covered with a lime-salt coating ranging from 1/16 in. to ⅛ in. in thickness. The ribbon anode appeared to be about 80% consumed and the effective life of the installation was estimated at about five years.

This application illustrates the effectiveness of the ribbon anode in waters of comparatively poor conductivity and demonstrates the ease with which it can be shaped to give a configuration affording good distribution of protective current over the internal surfaces of closed vessels.

High Conductivity Media

In cathodically protecting structures exposed to attack by seawater or natural brines, it is often advantageous to apply a very high current density (50 ma/sq ft) for a short period of time (5 to 15 days) at the outset.[4] This serves to arrest corrosion immediately and, by laying down a calcareous film on the cathode metal, stabilizes the corrosion load on the structure at a substantially lower level. The main body of the installation may then be designed for a current requirement which is both lower and more stable than would otherwise be the case.

[4] U.S. Patent No. 2,200,469.

TABLE 3. Leak Repair Record

Year	Total Leaks	Leaks in Protected Sections	% of Total Leaks in Protected Sections
1944	3	0	
1945	22	7	
1946	12	1	22%
1947	21	7	
1948	12	0	
(Galvo-line installed Dec. 1, 1948)			
1949	101	3	
1950	70	0	1.4%
1951	41	0	

TABLE 4. Effect of Soil Resistivity

Sample No.	Days in Service	Soil Resistivity* ohm-cm	% Weight Loss	% Weight Loss/Yr
1	890	5,000 (7,500)	12.3	5.0
2	890	1,800 (3,300)	14.6	6.0
3	890	2,000 (2,300)	25.8	10.6
4	890	4,300 (3,500)	17.1	7.0
5	890	3,000 (3,100)	15.8	6.5
6	890	7,750 (17,500)	14.6	6.0

*Resistivity was measured with the megger at 2½-ft pin spacing. Values in parentheses were obtained with the L & N soil bridge on samples taken at ribbon depth.

In the electrolytes having high conductivity, Galvo-line offers a portable current source of high output and can be used effectively to prepolarize a corroding structure as described above.[5] Its use in this manner has been described in some detail by E. P. and G. L. Doremus[6] who have used it effectively in the cathodic protection of offshore drilling rigs in the Gulf of Mexico. In seawater the ribbon anode will devolop current flows of as much as 1 amp/ft in lengths up to about 20 ft if the lead wire resistance is sufficiently low. When used as described above, 1 ft of Galvo-line suffices to polarize and coat about 10 sq ft of cathode metal. The anode life under these conditions ranges from 5 to 10 days.

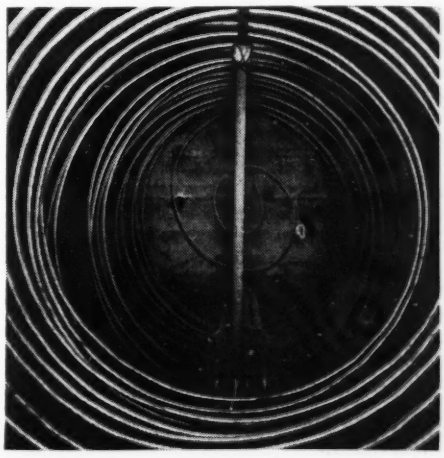
Summary

The magnesium ribbon anode has been field tested and found to provide effective, economical protection in several different applications. For underground use it offers the advantages of rapid, mechanized installation, better distribution and more efficient utilization of protective current, and simplicity of installation design. Underground tests show that comparatively large (10-ft) bare pipe can be protected with excellent current economy and that an anode life of as long as 10 years can be obtained in soils of 2000 ohm-cm resistivity and above. A purified magnesium (Mg-1) gives performance superior to that of cell magnesium as regards anode efficiency and uniformity of anode consumption.

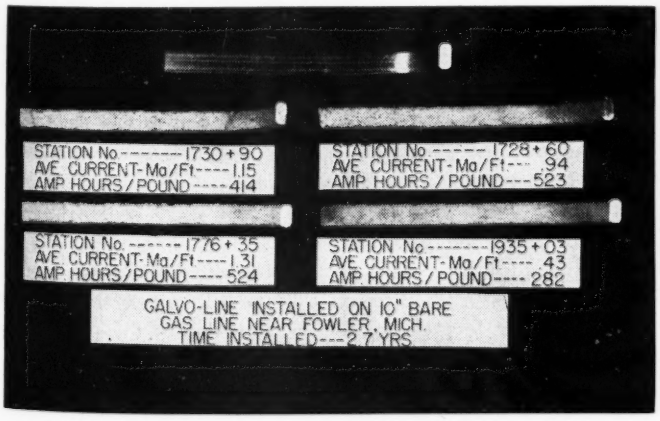
The ribbon anode has been used effectively to protect a large water heater processing water of relatively poor conductivity. An important feature of the ribbon in such applications is that it can readily be shaped or otherwise arranged to give configurations affording good current distribution and a high current output. In seawater and natural brines it offers a portable current source of very high output (0.5-1.0 amp/ft) and is useful in the application of lime-salt coatings for purposes of reducing the current required for subsequent cathodic protection.

Essentially, the ribbon anode is characterized by its high current output/j weight ratio and thereby affords a means of realizing a maximum amount of protection with a minimum of investment in anode metal and installation expense. By virtue of design, its use must necessarily be confined to soils and waters of intermediate to high resistivity (2000 ohm-cm and upward) if long life is desired. When used in electrolytes of low resistivity it should be allowed to operate unrestricted if efficient use of the anode metal is a consideration of any importance. The ribbon anode was designed not to replace but to supplement the cast anode.

Fig. 10. Arrangement of ribbon to protect interior of hot fresh water tank (looking down into tank).



[5]U.S. Patent No. 2,571,062.
[6]*Corrosion*, Vol. 6, No. 7, 216-224, (1950) July.



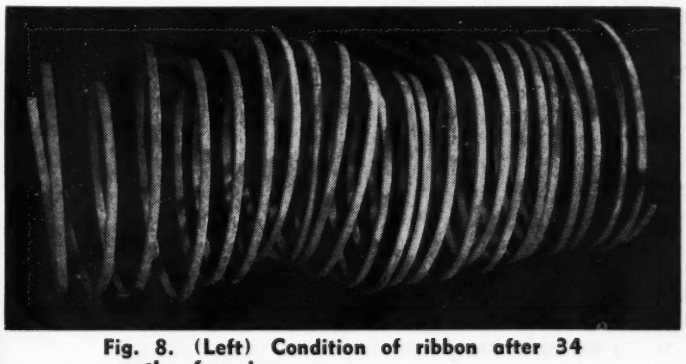


Fig. 8. (Left) Condition of ribbon after 34 months of service.

Fig. 9. (Above) Ribbon installed at Station No. 1728-60 as shown in Fig. 8. Average current, Ma/ft — 94; amp hours/lb — 523.

An Industry Need:

Standardization of Truck Bodies

By BROOKE DALY
McCabe-Powers Auto Body Co.
St. Louis

Exclusive

THE term "standard" has been defined as a "criterion of excellence." With this in mind, we approach our subject somewhat cautiously.

Since the origin of the word "fleet," as it applies to motor vehicles, the automotive industry has constantly been harangued with the ever-increasing need for cost reduction. Not only has this need been felt in the original purchase price of motor vehicles and associated items, but it has also become increasingly important insofar as operational expenses are concerned.

The motor vehicle, like other capital equipment, pays its way only when it is being used. Every precaution should, therefore, be taken that the time during which it is hospitalized for repairs is held to a minimum. The importance of continuous operation is more vital to the gas utility than to the ordinary commercial user, since an out-of-order utility vehicle may mean idleness for an entire crew of workmen.

The need for reduced operating costs is readily apparent. It, in turn, gives rise to the need for centralized control, a goal which many operating companies have achieved to a high degree of effectiveness. The matter of centralized control, while fairly simple in one operating company, may be most difficult to attain in another. A company whose operation is far flung is confronted with many problems not prevalent in the organization whose activities are primarily local.

Meter changeover unit is desirable for use when a large number of meters must be carried.

Many companies have been slow to recognize that the motor vehicle's effect on operating departments renders mandatory the need for motor vehicle supervision of the highest caliber. The transportation department has been viewed by management as a service department rather than an operating department. Although this is true, the magnitude of capital investment represented by the motor vehicle fleet is of sufficient importance to warrant special attention. When top-flight supervision of the motor vehicle program has been established, the accomplishment of cost reduction is all but assured.

With this premise established, the treatment of special truck bodies for individual gas companies, or for the entire gas industry, becomes somewhat less complicated. Among distribution companies, some of the more common uses for special truck bodies include meter installation, meter changeover, appliance delivery, gas line construction and maintenance, and last, but not least, leak detection and repair. In the transmission companies, special bodies are used primarily for line construction and for the maintenance of lines and company stations.

In reality, the term "special bodies" is no longer applicable, inasmuch as these units have come to be known as utility truck bodies. The utility truck body is a product of the depression. During that trying period, operating companies used every conceivable means to reduce costs. The elimination of extra trips from the job to the warehouse or shop was a must. This was accomplished, to a large degree, through the use of compartment-type truck bodies. One engine was made to do the work of two through the use of power takeoff equipment which enabled an air

Mr. Daly is vice president of McCabe-Powers, as well as manager of the Powers-American Utility Body Division.

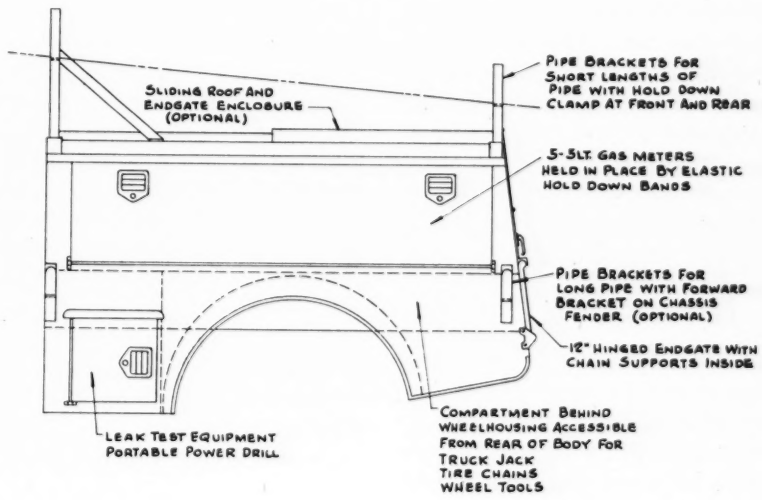
Leak detection and repair unit equipped with three-man crew compartment and engine-driven air compressor. Note hose reel in lower rear compartment.

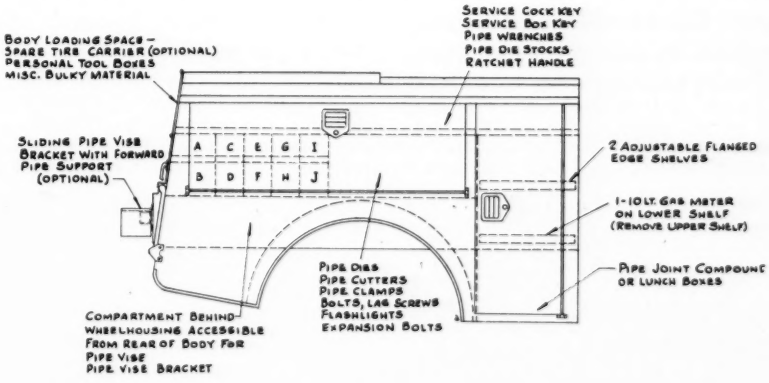
Meter installation and general service body accommodates five 5-lt tin meters in left horizontal compartment and one 10-lt meter in right vertical compartment.

compressor, welder, pump, or other mechanical device to be driven by the truck engine. These are but a few of many examples which can be cited to show the manner in which utility bodies and related items have cut operating expenses.

What is meant then when we speak of standardizing truck bodies and what are we trying to accomplish? Our primary objective is similarity, not only in exterior appearance, but also insofar as the normal load is concerned. It is obviously not good practice for one crew to carry a surplus of tools and materials, while another crew has an insufficient supply. Such a situation can be overcome, of course, by the use of carefully planned loading charts and diagrams. Although these charts require considerable work and forethought, they are invaluable from the standpoint of proper vehicle loading and reduced inventory. To assure that loading instructions are carried out, rigid periodic inspection is required.

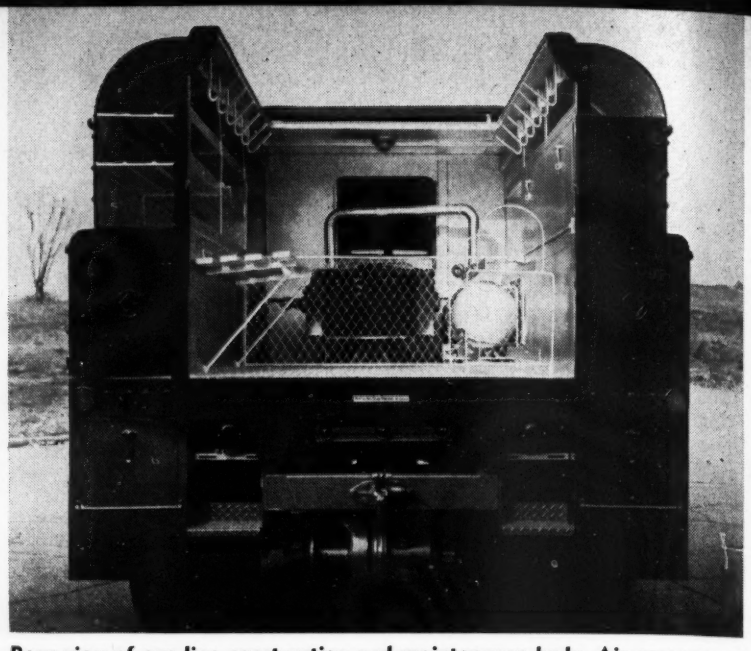
Before any progress can be made on standardization, it is necessary to make a complete study of the operation in question. This can best be accomplished by the motor vehicle supervisor, in conjunction with the men who are responsible for the work to be done. The formation of a committee consisting of operating superintendents, with the motor transportation superintendent as chairman, is one good method of approach. As chairman, it is imperative that the motor vehicle superintendent have full authority to carry out recommendations and decisions made by the committee. Each member of this committee must view the standardization program with an open mind. He must realize that his contemporaries will present good workable


SLIDING ROOF AND ENDGATE ENCLOSURE (OPTIONAL)
PIPE BRACKETS FOR SHORT LENGTHS OF PIPE WITH HOLD DOWN CLAMP AT FRONT AND REAR
5-5LT. GAS METERS HELD IN PLACE BY ELASTIC HOLD DOWN BANDS
PIPE BRACKETS FOR LONG PIPE WITH FORWARD BRACKET ON CHASSIS FENDER (OPTIONAL)
12" HINGED ENDGATE WITH CHAIN SUPPORTS INSIDE
LEAK TEST EQUIPMENT PORTABLE POWER DRILL
COMPARTMENT BEHIND WHEELHOUSING ACCESSIBLE FROM REAR OF BODY FOR TRUCK JACK TIRE CHAINS WHEEL TOOLS


BODY LOADING SPACE — SPARE TIRE CARRIER (OPTIONAL) PERSONAL TOOL BOXES MISC. BULKY MATERIAL
SERVICE COCK KEY SERVICE BOX KEY PIPE WRENCHES PIPE DIE STOCKS RATCHET HANDLE
SLIDING PIPE VISE BRACKET WITH FORWARD PIPE SUPPORT (OPTIONAL)
A C E G I
B D F H J
2 ADJUSTABLE FLANGED EDGE SHELVES
1-10LT. GAS METER ON LOWER SHELF (REMOVE UPPER SHELF)
PIPE JOINT COMPOUND OR LUNCH BOXES
PIPE DIES PIPE CUTTERS PIPE CLAMPS BOLTS, LAG SCREWS FLASHLIGHTS EXPANSION BOLTS
COMPARTMENT BEHIND WHEELHOUSING ACCESSIBLE FROM REAR OF BODY FOR PIPE VISE PIPE VISE BRACKET

Specimen Loading Chart for Meter Installation and General Service Truck Body

Bin A—50-1/2" Elbows or 40-3/4" Elbows
Bin B—25-1" Elbows or 10-1 1/2" Elbows
Bin C—30-1/2" Unions or 25-3/4" Unions
Bin D—18-1" Unions or 10-1 1/2" Unions
Bin E—26-1/2" Tees or 20-3/4" Tees
Bin F—12-1" Tees or 7-1 1/2" Tees
Bin G—72-1/2" Couplings or 50-3/4" Couplings
Bin H—30-1" Couplings or 12-1 1/2" Couplings
Bin I—140-1/2" Cl. Nipples or 90-3/4" Cl. Nipples
Bin J—60-1" Cl. Nipples or 36-1 1/2" Cl. Nipples



Rear view of gas line construction and maintenance body. Air compressor installed in forward portion of body loading area is engine driven by means of a power takeoff. Note air winch for backfilling, installed at rear.

ideas, and must be willing to compromise.

This is an ideal time to consult with a representative of a reliable manufacturer of truck body equipment. By so doing, many pitfalls in the preparation of body specifications can be avoided. It is also possible to eliminate some manufacturing problems, which might otherwise develop at a later date.

In working out suitable body standards for use within a particular company, many points must be considered. The practicability of the equipment, not only from the standpoint of the user, but also from the standpoint of its availability, cannot be overlooked. It is equally important that the body design be sufficiently flexible to permit it to be adapted to the various makes of truck chassis which are available. The necessity for maintaining a low manufacturing cost cannot be over-emphasized and, for this reason, the preparation of specifications to be used in bidding is of the utmost importance.

Under present day practices, it is not unusual for reputable manufacturers to be excluded from participation because of inadequate or poorly prepared specifications. One of the more common errors is to specify a vehicle which is not suitable for the job at hand. This mistake and many others can be avoided by consultation with a body manufacturer.

Several companies devote virtually their entire effort and facilities to the development of truck bodies and equipment designed specifically for utility work. A competent representative of a recognized utility body manufacturer can assist in solving many standardization problems. His knowledge of existing standards and manufacturing techniques, coupled with his experience in working with others, enables him to be of inestimable value.

The utility body manufacturers, in all probability, are most interested in the problems of standardization. They are concerned with advancing standardization, not only within an individual company, but in the entire gas industry. The attainment of this goal will, of certainty, go far in the reduction of overall operating costs. There are several ways in which progress can be made in this direction.

It is our belief that the first step must be taken by the operating men within the gas industry. At some of the association meetings, for instance, it would be possible for committees to be formed. These committees should consist of individuals representing various companies, but all interested in a particular phase of the gas industry.

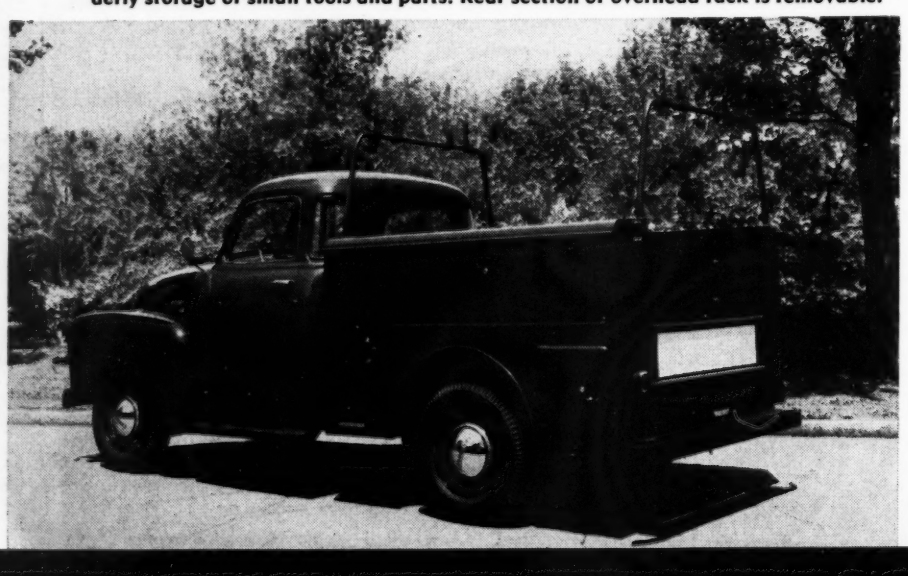
As an example, the meter department supervisors could meet and determine the requirements of a vehicle to adequately handle meter installation work. By this we do not mean for them to design a suitable truck body, but rather to determine the requirements of that truck body. With this information well defined, it will then be possible for the body manufacturers to perfect a design which will be widely accepted by the operating companies. The establishment of basic requirements by the operating personnel is of utmost importance. With this accomplished, the body manufacturers will be in a position to design and build equipment which could conceivably find wide acceptance.

The accompanying photographs show various types of bodies which have been adopted as standard units by some of the major gas companies. Each of these bodies has outstanding features. It is the duty of the body manufacturer to introduce these features to the gas industry and to urge their adoption. Only through this procedure can any degree of excellence in standardization be accomplished.

In conclusion, we may be sure that the importance of standardization is readily apparent. It improves vehicle efficiency. It provides similarity of appearance for the purpose of advertising and public relations.

The difficulties of accomplishing standardization of truck bodies should not be underestimated. To accomplish any degree of progress, centralized control and supervision are of utmost importance. Through good supervision, a thorough study of the problems can be made in cooperation with operating personnel. Body manufacturers are willing assistants, as it is only through surveys of this type that they are better able to serve the gas industry. It is not unreasonable to expect that at some future date standardization, that "criterion of excellence," may be accomplished.

Appliance delivery and service body equipped with shelves and parts bins for orderly storage of small tools and parts. Rear section of overhead rack is removable.



External Sealing

Of Bell and Spigot Joints on Cast Iron Mains

By FRANK V. WILBY
Southern California Gas Co.
Los Angeles

IN the earlier days of the gas industry bell and spigot joints in cast iron mains were commonly sealed by tamping in oakum and then pouring in and calking a layer of lead. Much improved and more permanent methods of joining cast iron pipe are now used. However, there remains in service a considerable amount of cast iron pipe joined by the older method of oakum and lead.

Lead has little resilience so any relative movement of the pipes at the joint as caused by settling or vibration may permanently deform the lead and result in leakage. However, in mains carrying manufactured gas, the high content of water and higher hydrocarbons keeps the oakum swollen, effectively sealing the joint.

Enter Natural Gas

With the advent of dry natural gas the oakum dries out, losing its sealing ability. In the latter case, a leaking bell and spigot joint cannot be sealed satisfactorily merely by recalking the lead. Subsequent deformation of the lead will result in leakage since the dried-out oakum is no longer an effective seal. To provide a positive seal for leaking bell and spigot joints, it is general practice in the gas industry to install mechanical leak clamps. They consist of a thick rubber gasket compressed against the joint by a suitable clamp, usually of malleable iron.

Sometimes, however, installation of a mechanical leak clamp is not feasible. A nearby structure may not allow sufficient clearance or the pipes may be joined at a considerable angle. About the only recourse in such cases has been to recalk the joint as well as possible or to devise an alternative method of sealing.

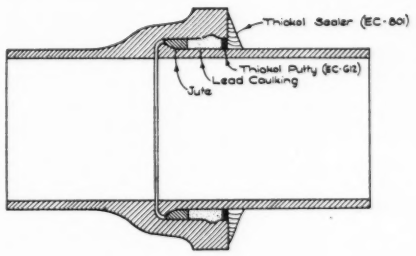


Fig. 1. Method of applying putty and sealer to bell and spigot joint.

The need for an alternative method is illustrated in the analysis made by G. Taylor[1] of the Pacific Gas & Electric Co., San Francisco. During its 1948 clamping program, 3276 clamps were installed but 205 joints could not be clamped, principally because of the angle of the pipes at the joint.

At the 1949 Pacific Coast Gas Assn. distribution conference, H. M. Hoppe[2] of the Southern California Gas Co. described a method whereby 32 bell and spigot joints in a 30-in. cast iron gas main were sealed internally by means of Thiokol sealer (EC-801) and Thiokol putty (EC-612)[3]. The Thiokol sealer consists of two parts, unpolymerized Thiokol and an accelerator. When the two are mixed, the Thiokol polymerizes at room temperature to form a gel in 3 to 4 hours and cures a tough rubber in 2 to 3 days. When applied to clean metal the Thiokol develops a bond of better than 80 psi and a Shore durometer hardness of 45 to 50. Thiokol is markedly resistant to hydrocarbon solvents, including aromatics, and is inert to chemical agents found in the soil or the gas.

The Thiokol putty is a very stiff nonhardening plastic material which will bond well to very clean metal. This putty does not flow readily and may be used as a gap filler and backing for the Thiokol sealer.

Since the previously mentioned internal sealing job was completed, there has been occasion to seal externally two joints of a 30-in. cast iron main which were located so close to adjacent substructures that installation of mechanical leak clamps was impractical. The main carried gas at 3 psig and a continuation of service at this pressure was desired. These joints were sealed by first calking the lead as well as possible and then applying a thick layer of Thiokol sealer held in place by metal bands. Some leakage remained after the calking and bubbles formed in the Thiokol sealer. As the sealer hardened, the bubbles were worked out and the sealer was pressed back into place. This difficulty in stopping all leakage until the sealer had cured suggested the need for a suitable putty which could act as a preliminary seal.

External Problems

The application of plastic sealers to the external sealing of joints in a main under pressure presents more difficulties than does internal sealing. In the latter case, the sealing material may be allowed to cure before the main is pressured, and when the sealed joint is placed in service the gas pressure tends to hold the sealing material in place.

Periodically it has been necessary to resort to external sealing with Thiokol sealer and putty where clamps could not be applied. The method of application is illustrated in *Fig. 1*. Although so far only these Thiokol compounds have been employed, the same general considerations will apply to the use of other similar sealing materials such as neoprene.

A clean metal surface is prerequisite

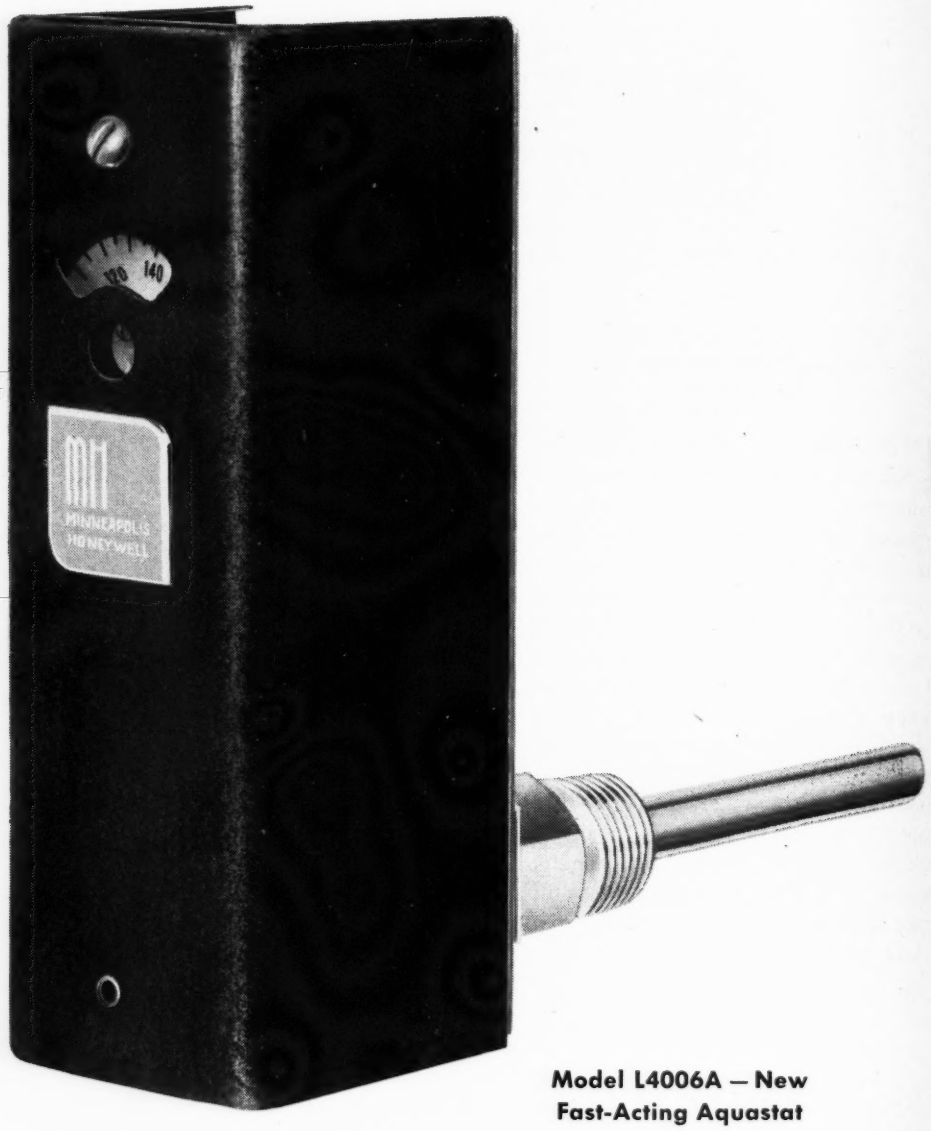
Presented at the PCGA technical services conference in Fresno, Calif., March 5-6.

[1] Taylor, G. "Cast Iron Leak-Clamping." *Proc.*, Pacific Coast Gas Assn., 40, 144-5 (1949).

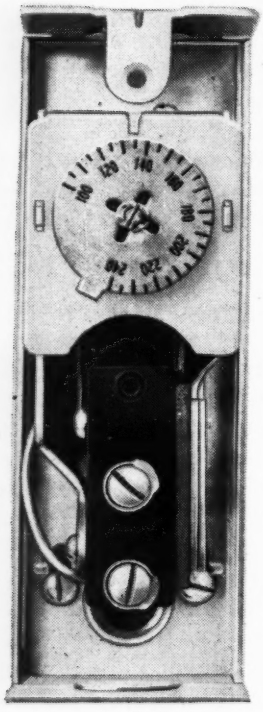
[2] Hoppe, H. M. How Joint Leaks on Cast Iron Main Were Repaired Internally. *GAS*, May 1949, p. 38. Also see PCGA *Proc.*, 40, 141-4 (1949).

[3] The Thiokol compounds mentioned are products of Minnesota Mining & Manufacturing Co.

Smash Story from Honeywell . . .



Model L4006A — New Fast-Acting Aquastat



Model L4006 with cover off

Look at these new features . . .

1 New sensing element!

All six models use the new, improved Honeywell sensing element to rapidly detect and respond to temperature changes.

2 New, enclosed Micro switch!

Switching on every model is accomplished by a new, *enclosed-type* Micro switch.

3 New, simplified horizontal mounting!

All models convenient and easy to install in boiler. (See pictures, right)

Six fast-acting models available — for every need!

L4006A — SPST. Opens on temperature rise. With immersion well.
L4006B — SPST. Closes on temperature rise. With immersion well.
L4006C — SPST. Opens on temperature rise. Bulb directly immersed.
L4006D — SPST. Closes on temperature rise. Bulb directly immersed.
L6006A — SPDT. With immersion well.
L6006B — SPDT. Bulb directly immersed.

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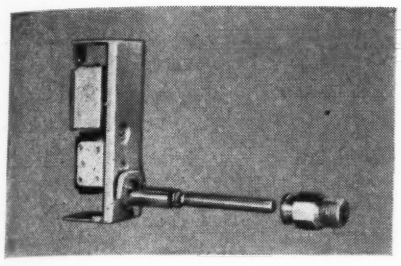
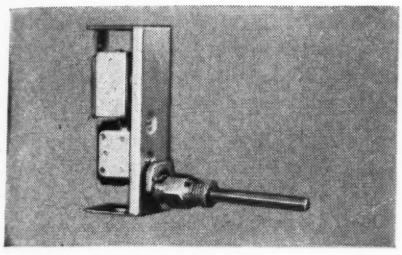
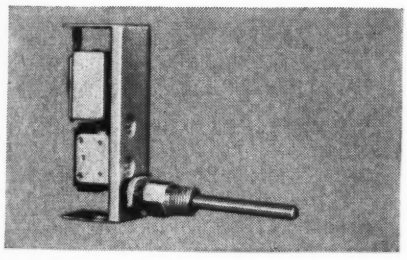
New Simplified Installation!
for Aquastats without well



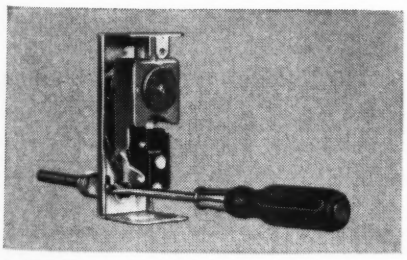
1. Special, simplified boiler fitting, (right, above), now furnished on models without well. Screw this fitting into boiler.



2. Simply insert Aquastat into the fitting. (Notice collar on back plate which raises to give Aquastat snug, flush fit!)



3. Lower collar into place. (A similar collar is also furnished with the well model Aquastat.)



4. Merely tighten screws on inside of back plate; slip on cover, set control point and *Aquastat is installed!*

Vastly improved—easy to install—more sensitive than ever before!

MEET the L4006—the newest and most modern line of Aquastats ever designed by Honeywell for hot water heating systems!

Developed by Honeywell control engineers, this new, immersion-type Aquastat, besides being more sensitive by actual test, is also easy to install, service and adjust. The control point can be easily set *externally,* with a screw driver.

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Fig. 2. Joint in 12-in. cast iron main after sandblasting. Vault wall prevented use of mechanical clamp.

Fig. 3. Joint after application of putty.

Fig. 4. Completed seal.

to obtaining a good bond. This is best achieved by sandblasting. Graphitized areas should be cleaned down to the sound metal and the resulting dust flushed away by a volatile solvent such as ethylene dichloride. Thiokol sealer forms a chemical bond to the metal through sulfur linkages, so no primer is required. *Fig. 2* shows a 12-in. joint after it had been sandblasted. Installation of a mechanical clamp was precluded in this case because of insufficient clearance between the bell and the wall of a vault.

In its unpolymerized state the Thiokol sealer has no ability to seal off leakage, so a preliminary seal is effected by working the Thiokol putty into the calking recess as shown in *Fig. 3*. Sandblasting greatly facilitates this operation because it makes possible the thorough cleaning of this irregular area and the bonding of the putty is greatly enhanced. The putty should be applied carefully so as to stop all leakage and thus prevent the formation of bubbles in the Thiokol sealer, which is applied next. The sealer is brushed or troweled on to form a generous fillet, as shown in *Fig. 4*.

The joint cannot be soap tested for leaks until the seal is completed because it has been found that soap impairs the bond of the Thiokol sealer and putty to the metal. Any leaks that might become apparent after the seal is completed but before the Thiokol has cured may be stopped by working in the Thiokol putty.

At the present stage of development the sealed joint is allowed to stand overnight so that any leakage might be detected and repaired before backfilling. Several days are required at ordinary temperature for the Thiokol sealer to achieve full cure but the cure may be accelerated by heat. The joint is wrapped with asbestos pipe wrapping felt to shield the seal against damage during backfilling.

The practicability of using plastic sealers for the internal sealing of joints has been fairly well demonstrated but they can be applied only to pipe large enough to permit entry of a man. For external sealing, they were at first employed only where mechanical leak clamps could not be applied, but it soon became evident that plastic sealers might possess some advantages over mechanical leak clamps for the sealing of low pressure gas mains. Corrosion may limit the life of mechanical clamps, as their metal and particularly that of the bolts is often anodic to the cast iron of the main. It is difficult to design a mechanical leak clamp which will fully contain the rubber gasket. In time, plastic flow of the compressed rubber gasket may occur causing a relaxation of the pressure of the rubber against the joint and thus decreasing the effectiveness of the seal.

Plastic materials are available which are resistant to the action of all constituents normally found in either the gas or the soil. Plastics can be formulated with any degree of flexilibity so that movement of the joint will not damage the seal. If mechanical clamps are to be installed on old cast iron pipe that is badly pitted, the irregularities either must be ground down or filled to provide a bearing surface for the rubber gasket. The application of plastic sealers is not affected by surface irregularities.

A plastic seal of the type presented here is under no physical restraint so there is no tendency for the plastic to flow. Any bell and spigot joint could be sealed with one basic set of plastic materials, whereas mechanical clamps must be stocked in various sizes. The material costs of plastic sealing are attractive. Thiokol is one of the more expensive plastic compounds, yet the material cost of sealing a 12-in. joint is about $3. A good estimate of the labor costs cannot be made at this time, but they should not be radically different from those for installing mechanical leak clamps.

The external sealing of bell and spigot joints with plastic sealers also has some less favorable aspects. Plastic sealers can be used only on mains carrying gas at low pressures not exceeding a few pounds. The long-term resistance to deterioration of the bond of the plastic to the metal remains to be determined. However, one sealed joint was inspected after being buried 16 months and it was found to be in perfect condition. Susceptibility to damage during backfilling and tamping may be a limiting factor, especially in rocky soils; but suitable shielding of the joint could mitigate this problem. Preparation of the plastic sealer components and their application may be critical, requiring specially trained crews.

To date most of our experimental work has been conducted with the previously mentioned Thiokol materials. Unfortunately these materials are not available at present, all available production being used in the current armament program. However, the plastics industry has developed many other materials which appear to have good possibilities and would warrant investigation.

Acknowledgments

The initial inspiration for this work came from W. M. Henderson. The earlier work on external sealing was done by C. E. Lee, assisted by H. E. Goldsbrough.

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SUMMARY OF ANNUAL RESERVES ESTIMATES

(Millions of Cubic Feet—14.65 psia, at 60° F)

	1945	1946	1947	1948	1949	1950	1951
Previous year's reserves		147,789,367	160,575,901	165,926,914	173,869,340	180,381,344	185,592,699
Extensions and revisions		a	7,570,654	9,769,483	8,061,429	9,172,381	13,013,606
Discoveries		a	3,410,170	4,129,089	4,612,870	2,877,351	3,039,385
Totals: Extensions, revisions, discoveries		17,729,152	10,980,824	13,898,572	12,674,299	12,049,732	16,052,991
Net change in storage		a	a	51,482	82,746	54,301	132,751
Net production in 1951		4,942,617	5,629,811	6,007,628	6,245,041	6,892,678	7,966,941
Estimated proved reserves as of Dec. 31	147,789,367	160,575,901	165,926,914	173,869,340	180,381,344	185,592,699	193,811,500
Increase over previous year		12,786,535	5,351,013	7,942,426	6,512,004	5,211,355	8,218,801

a Not estimated.

Net gain 8.2 trillion

Proved Reserves Now 194 Trillion

PROVED recoverable natural gas reserves on Dec. 31, 1951, totaled 193.8 trillion cu ft, an increase of 8.2 trillion over estimated reserves a year earlier and a new record high level. A joint report of the AGA Committee on Reserves and the American Petroleum Institute shows that the increase is the second highest made since the estimates were started, and it was registered over an all-time production high of about 8.0 trillion cu ft during 1951.

Estimated reserves of natural gas in underground storage at the end of the year were 132.8 billion cu ft greater than at the end of 1950.

Greatest gains by individual states were scored by Nebraska and New Mexico whose natural gas reserves increased 117.2% and 65.8%, respectively, over 1950's year-end estimates. Despite the general increase, seven states showed decreases from the previous year's estimates: California, Illinois, Indiana, Kansas, Kentucky, Mississippi, and Pennsylvania.

Natural gas liquids reserves had risen to 4.72 billion bbl at year's end, compared with 4.27 billion at the end of 1950. Record production of 267 million bbl of natural gas liquids was recorded during 1951. Crude oil reserves increased, too, from 1950's 25.26 billion bbl to 27.47 billion. Total estimated liquid hydrocarbon reserves on Dec. 31, 1951 were 32.19 billion bbl, compared with 29.54 billion a year earlier.

The increase of 13 trillion cu ft in proved natural gas reserves through extensions and revisions of previous estimates for existing fields reflects the results of improved drilling methods and increased exploration. Discoveries of new natural gas fields and new pools in old fields accounted for an important 3 trillion cu ft addition to the reserves.

New pipelines serving metropolitan New York and New England and increased residential and industrial use in other areas were largely responsible for the high level of production of natural gas.

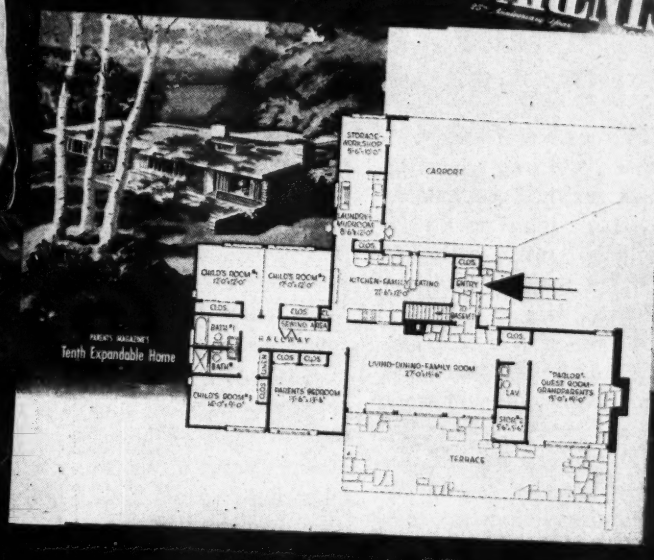
ESTIMATED PROVED RECOVERABLE RESERVES OF NATURAL GAS

(Millions of Cubic Feet—14.65 psia, at 60° F)

	Reserves[B] as of Dec. 31, 1950 (1)	Changes in Reserves During 1951: Extensions and Revisions[B] (2)	Discoveries: New Fields, Pools in Old Fields[B] (3)	Net Change, Underground Storage[C] (4)	Net Production[D] (5)	Reserves as of Dec. 31, 1951[B]: Total (All columns less "Net Production") (6)	Non-Associated[E] (7)	Associated[F] (8)	Dissolved[G] (9)	Underground Storage[H] (10)
Arkansas	907,593	27,545	38,965	(-) 4	42,785	931,314	478,298	149,733	301,287	1,996
California[I]	9,760,386	170,711	66,827	(-) 4,317	511,162	9,482,445	2,615,335	2,155,881	4,696,387	14,842
Colorado	1,115,473	22,955	24,504	0	24,481	1,138,451	487,134	42,142	609,175	0
Illinois	229,893	29,795	5,650	0	38,205	227,133	4,333	10,000	212,800	0
Indiana	31,190	2,520	3,340	297	6,540	30,807	3,500	4,500	21,760	1,047
Kansas	13,790,834	76,206	40,971	2,326	452,839	13,457,498	13,015,271	133,419	277,181	31,627
Kentucky	1,330,583	59,386	9,520	(-) 401	73,500	1,325,588	1,253,003	0	61,400	11,185
Louisiana[I]	28,533,266	1,147,998	480,933	0	1,157,166	29,005,031	23,147,675	3,829,371	2,027,985	0
Michigan	195,074	8,786	230	10,347	11,412	203,025	119,011	0	41,366	42,648
Mississippi	2,519,206	86,321	35,477	40	201,075	2,439,969	1,721,717	405,552	312,660	40
Montana	797,361	69,336	0	3,069	41,659	828,107	700,358	39,469	80,717	7,563
Nebraska	44,106	30,947	26,646	0	5,889	95,810	67,351	7,906	20,553	0
New Mexico	6,990,670	4,785,791	132,187	(-) 2,834	315,835	11,589,979	8,273,960	2,351,741	949,026	15,252
New York	64,779	100	0	4,814	2,900	66,793	50,642	0	528	15,623
Ohio	658,862	32,527	8,450	30,696	41,400	689,135	551,825	0	32,800	104,510
Oklahoma	11,634,287	769,182	117,604	10,380	727,116	11,804,337	7,368,214	1,007,720	3,393,654	34,749
Pennsylvania	627,171	38,272	33,000	43,012	122,000	619,455	480,191	0	38,400	100,864
Texas[I]	102,404,077	5,311,803	1,854,153	1,330	3,918,134	105,653,229	70,322,632	18,228,896	17,099,881	1,820
Utah	84,752	8,784	6,154	0	3,845	95,845	78,720	0	17,125	0
West Virginia	1,650,675	147,107	21,900	33,817	182,000	1,671,499	1,504,366	0	77,150	89,983
Wyoming	2,194,989	161,115	66,518	179	82,503	2,340,298	1,479,958	354,385	505,263	692
Miscellaneous[A]	27,472	26,419	66,356	0	4,495	115,752	47,913	0	67,839	0
Total	185,592,699	13,013,606	3,039,385	132,751	7,966,941	193,811,500	133,771,407	28,720,715	30,844,937	474,441

[A] Includes Alabama, Florida, Maryland, Missouri, North Dakota, and Virginia.
[B] Excludes gas loss due to natural liquids recovery.
[C] The net difference between gas stored in and gas withdrawn from underground storage reservoirs, inclusive of adjustments.
[D] Net production equals gross withdrawals less gas injected into producing reservoirs; changes in underground storage are excluded. December production estimated occasionally.
[E] Non-associated gas is free gas not in contact with crude oil in the reservoirs.
[F] Associated gas is free gas in contact with crude oil in the reservoirs.
[G] Dissolved gas is gas in solution with crude oil in the reservoirs.
[H] Gas held in underground reservoirs for storage purposes only.
[I] Includes off-shore reserves.

AMERICAN-Standard
HEATING



AMERICAN-Standard Winter Air Conditioner selected for nationally featured all-gas home

THE plans shown above are of Parents' Magazine's 10th Expandable Home. First introduced through the editorial columns of that widely read magazine last fall, this interesting *all-gas* home has been enthusiastically received by thousands of growing families who welcome its modern conveniences and "expandable" possibilities.

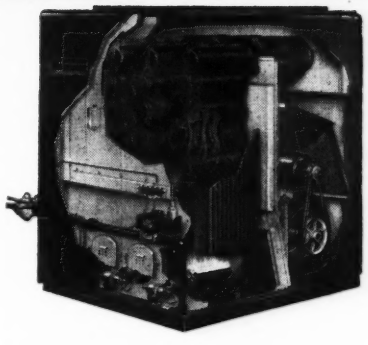
One of the most appreciated features of this very practical house that's designed for easier housekeeping, is its heating system, the heart of which is the Mohawk Winter Air Conditioner by American-Standard.

Parents' Magazine says the Mohawk was selected because it could do an all-around efficient and economical job of heating this modern home.

Such praise will doubtless prompt many families right in your own community to include gas heating in their modernization plans . . . and to install American-Standard equipment.

Every such installation along your mains means another satisfied gas customer . . . and lasting good-will for us both.

American Radiator & Standard Sanitary Corporation
P. O. Box 1226, Pittsburgh 30, Pa.



THE MOHAWK
Precision Engineered

Featuring cast iron construction for extra durability, longer life and quieter operation, the Mohawk is available in eight sizes, from 80,000 to 300,000 Btu input per hour. It features preheating of return air to save fuel and increase efficiency—has a cast iron heating element made in two sections with asbestos-packed leakproof joints. Its corrugated radiation shield minimizes heat loss into basement. And high temperature alloy ribbon burners burn manufactured, natural, mixed, liquefied petroleum, and LP-air gas uniformly and sparingly.

Serving home and industry

AMERICAN-STANDARD · AMERICAN BLOWER · ACME CABINETS · CHURCH SEATS · DETROIT LUBRICATOR · KEWANEE BOILERS · ROSS HEATER · TONAWANDA IRON

Portland's New Security Manual Blueprints Emergency Procedures

By R. H. GLASSLEY
Portland (Ore.) Gas & Coke Co.

THERE are all degrees of completeness in civil defense planning. Municipalities, as well as companies, show wide variances ranging all the way from general statements to intricate descriptions of every minute operation. Portland Gas & Coke Co. decided that every step in each bureau, division, and work center should be completely described.

Exclusive

Of course, the company has had for many years an emergency manual to meet all peacetime situations which may occur. In the case of civil defense, it was decided to call the manual the "Company Security Program," which would not only cover civil defense needs, but those of major catastrophes such as great conflagrations or floods.

The completed manual contains 220 pages of text, with 72 blueprints, maps and charts, plus more than 100 pages of other exhibits. This manual is divided into 73 chapters comprising six major sections, and embraces the assignments of about 300 individuals. To assist in the placement of employees on emergency work teams, a pin map showing residential locations of all employees is kept current, and assignments to teams are made with regard to the home addresses of the employees in relation to the nearest major installation center of the company's properties.

The general area covered by the company's distribution system services an area about 110 miles in length from north to south, and varying widths up to 60 miles. While the city of Portland contains the major plants and holder stations, supplementary holders, compressors, and other major equipment is to be found in many of the cities from Vancouver, Wash. to Corvallis, Ore.

Six master copies of the manual were provided, which copies will never leave the executive offices. These master copies contain information of a restricted nature, and therefore are withheld from general distribution. Distribution of the 73 chapters was made according to the responsibilities of each of the 300 employees concerned, and ranged from a single chapter to many chapters.

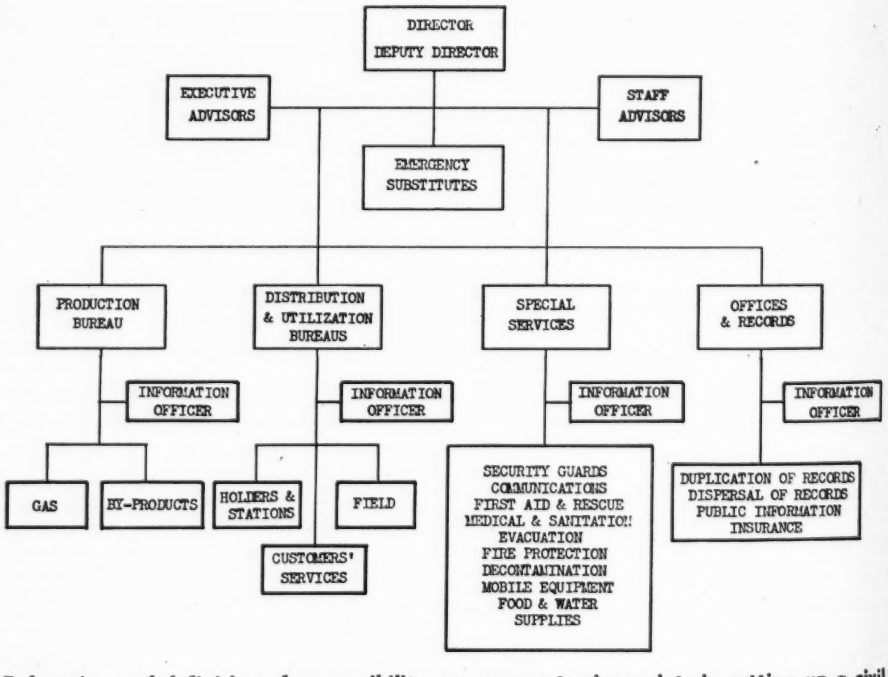
The blueprints, maps, and charts were coordinated with specifications detailed in the text. Every major valve in the entire system is numbered, its location shown on one of the exhibits, and exact measurements from street corners or other fixed points are described in the text. Instructions for shutting down and resuming operations of the major units of the gas plant and by-products plant are carried to the point of explaining the sequences in which valves should be turned off and on, various pipelines drained, as well as protective methods during shutdown.

Moreover, both minimum and maximum plans are provided for each operating unit. The minimum plan is the one already established, and is designed to be adequate for all conditions short of enemy attack or major catastrophe. The maximum plan is to be invoked if and when enemy action seems imminent, or immediately upon the onset of a great fire or flood.

To completely motivate the plan, application was made for the installation of a short-wave radio station. A site for the station was purchased, the necessary wave length was assigned, and all equipment is presently on hand in the city to equip the station. A considerable number of company-service vehicles are to be equipped with two-way radio, as are several of the executive offices.

The company's security program activities are coordinated with the metropolitan civil defense plan, within which is a subdivision comprised of all public utilities under a metropolitan deputy director. All public utilities in the city have been very alert to their responsibilities in case of disaster, and the setup provides an example of complete coordination which could be well utilized by any other city in the nation.

Representatives of the company have examined a great many manuals pertinent to civil defense, and they have concluded that it is very doubtful if a more completely organized project for this purpose can be found anywhere.



Delegation and definition of responsibility are proper starting points in setting up a civil defense plan. Portland Gas set up a major organization chart such as the one illustrated here, as well as a chart for each segment of the company, to establish the scope of each man's duties.

MURDER IN THE TANK!

A gripping tale that points a moral: water heater sales are easy when you sell...

Permaglas

AUTOMATIC GAS WATER HEATERS

1. "Ruthless Rust" . . . water heater enemy No. 1 . . . murders ordinary water heaters!

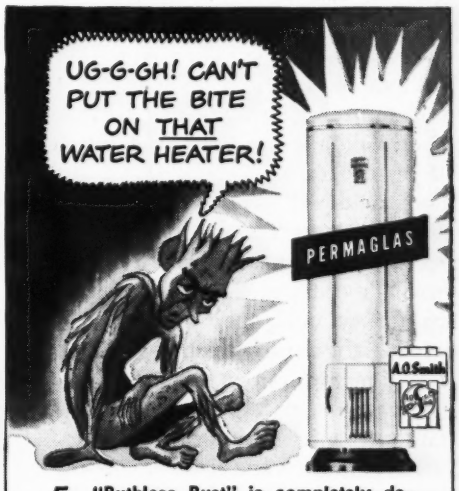
2. Four B. I. protects Permaglas Water Heaters with glass-surfaced steel tank!

3. "Ruthless Rust," still defiant, plans attack on fittings and exposed metals!

4. Four B. I. puts Officer Newt on the job to thwart Ruthless Rust's new attack!

THE FIRST water heater with a glass-surfaced steel tank that can't rust because *glass can't rust!*

THE ONLY water heater with Four B. I. Protection against all corrosive attack!



5. "Ruthless Rust" is completely defeated by Four B. I. Protection!

Millions of home owners . . . will read this uncensored story in full page ads in: LIFE, April 7th issue, April issues of BETTER HOMES AND GARDENS and LIVING FOR YOUNG HOME MAKERS . . . and in May issues of AMERICAN HOME and HOUSE BEAUTIFUL.

This advertising is the beginning of a continuing campaign that will keep *Permaglas* in commanding lead with nation-wide consumer acceptance.

Contact your *Permaglas* supplier for your Four B.I. promotion kit.

For the complete, uncensored story of "MURDER IN THE TANK" and how it can put more money in your pocket, write:

A. O. Smith Corporation, Water Heater Division
Dept. G-452, Kankakee, Illinois

There's only ONE *Permaglas* . . . and it

COSTS NO MORE

than ordinary water heaters!

A.O.Smith

AUTOMATIC WATER HEATERS

PERMAGLAS Water Heaters are completely protected from all corrosive attacks . . . protected by Four B. I., the four basic improvements provided by A. O. Smith in *Permaglas* Water Heaters, exclusively.

ONLY PERMAGLAS HAS

Four B. I. PROTECTION

The Four Basic Improvements are:

1. Glass-surfaced steel tank that can't rust because *glass can't rust!*
2. Absence of dissimilar metals inside the tank!
3. Interior tank fittings shielded from electrolytic action, the cause of all corrosion!
4. "Neutrolizer" . . . the anti-corrosion stand-by protector!

After range has passed test room examination, it is moved to one of four food kitchens for final workout. Here food staff prepares material for McCall's pages.

McCall's Test Rooms Play Dual Role in Checking Gas Appliances

Feature stories grow from test room findings, and from the test results the laboratories are able to help manufacturers develop better products.

By ALBERT P. McNAMEE
Manager, Home Appliances Marketing
McCall's Magazine

Exclusive

A man's home may be his castle, but it's his wife's workshop — and all kitchen and laundry appliances that go into it are her concern. Most women spend most of their time working at home, and for the past 80 years many of America's homemakers have been relying on *McCall's* for guidance and assistance in the solution of household problems. Today, this magazine ranks as third largest in the nation and in each issue many of its editorial pages are devoted to household equipment. Most important, *McCall's* often stresses the use of gas appliances, contributing to the growth of the gas industry through continuing education of millions of American homemakers.

You may well imagine that *McCall's*— when telling its readers of the pleasures of gas cookery — cannot afford to talk from the top of its editorial head. So, up in one of New York's greatest skyscrapers, overlooking fabulous Park Avenue, *McCall's* operates a modern and amazingly functional appliance test laboratory—eight test rooms and food kitchens gleaming with ranges, refrigerators, dryers, washers, and dozens of other up-to-date kitchen and laundry appliances.

Here, under conditions simulating as closely as possible those of the average household, appliances and other equipment supplied by 299 manufacturers are put through rigorous paces. All day long washers wash, dryers dry, ranges cook, and refrigerators refrigerate under the critical eyes of the household equipment editor, Elizabeth Sweeney Herbert, and her competent staff of home economists.

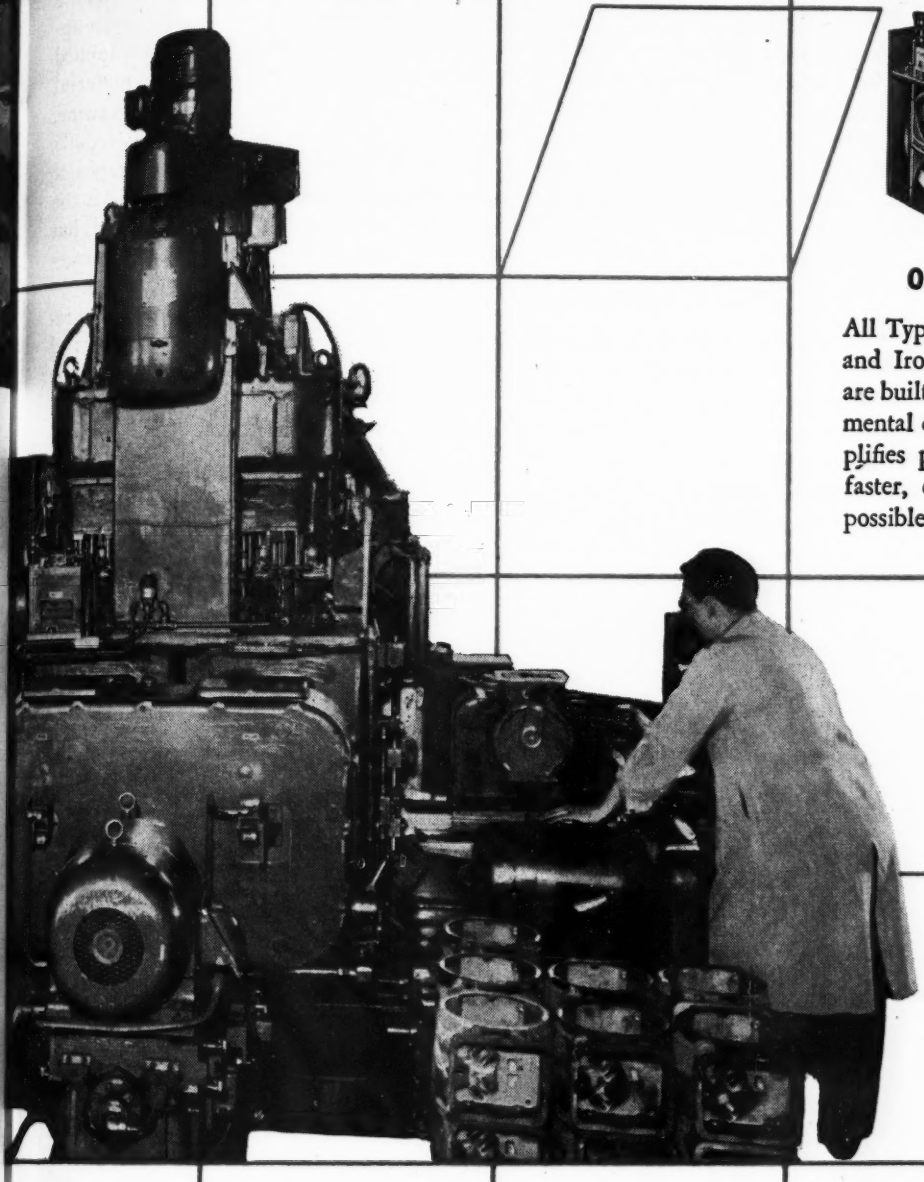
Here too, every taste-tempting food feature and recipe which is to appear in *McCall's* editorial pages is conceived and tested by the food editor, Helen McCully, and her assistants. The test rooms thus play a dual role in *McCall's* life— that of testing food and appliances which will appear editorially in the magazine, and that of testing new appliances, utensils, and household supplies as a service to manufacturers.

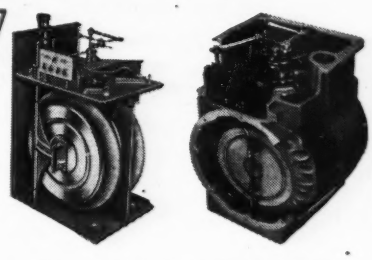
The test rooms, completely rebuilt just one year ago, occupy a total of 5134 sq ft and consist of eight busy kitchens completely equipped with ranges, refrigerators, sinks and cabinets, and other major appliances, plus a host of housewares; a gleaming laundry, the home of washing machines, ironers, dryers, and soapsuds; a temperature and humidity controlled room where technicians swelter or freeze when testing refrigerators, freezers, and clothes dryers; an appliance reserve room where new appliances wait their turn before entering the test rooms; a photography room where *McCall's* editors photograph those sparkling food and equipment spreads you see each month in the magazine; and last but not least, the compact offices of Elizabeth Sweeney Herbert, Helen McCully, and their staffs. These editors work just a hop, skip, and a jump from the very household conditions about which they write; small wonder their editorial features offer the kind of practical advice women welcome and use.

A rundown of special testing facilities for gas appliances indicates the lengths to which *McCall's* goes to give its readers accurate data on the use of this fuel. The test rooms are equipped with ten positions piped for gas range use, four gas refrigerator locations, four gas clothes dryer locations, and a 30-gal. gas water heater to provide hot water for three of the kitchens. All 18 gas locations have regulators to keep pressure constant. Three gas consumption meters, one portable and one of the wet type, measure fuel input during testing, while a pressure manometer accounts for the pressure variant. A flow meter is also used in testing procedures.

Household Equipment Editor Elizabeth Sweeney Herbert and Engineer Paul Schwind are the people who put appliances through their paces, devising testing procedures which are eminently practical rather than purely mechanical in nature. The technical aspects of the operation are supervised by Mr. Schwind, an ex-Navy engineer, while Mrs. Herbert and her staff of economists conduct test procedures which strive to duplicate home-use conditions to put appliances to the real test of everyday wear and tear.

AT LOWEST UNIT COST PER YEAR

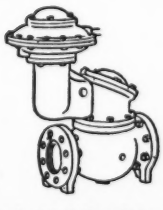




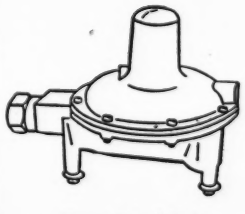
ONE STANDARD DESIGN

All Types and Sizes of Tinned Steelcase and Ironcase Displacement Gas Meters are built by *American* on the same fundamental design. This standardization simplifies parts stocking problems, assures faster, easier meter service and makes possible uniform shop practice.

Orifice Meters



Industrial Regulators



House Regulators

The efficiency and economy of *American* Meters is backed by more than 115 years of experience and by a constant purpose to provide the finest precision instruments known to gas measurement science.

American is and will continue to be the *first name* in metering dependability—always your *first choice for "Sustained Accuracy at Lower Cost."*

AMERICAN METER COMPANY MEASUREMENT ENGINEERS

AMERICAN® METER COMPANY

INCORPORATED (ESTABLISHED 1836)

Refrigerator Tests

As a starter, the refrigerator is broken-in" by being continuously run for one week. Actual testing begins with the "no load consumption test" during which the box is placed in the temperature and humidity control room at a temperature of 50° F and 50% relative humidity. Temperature is taken and fuel consumption checked at regular intervals during a 24-hour period. With intensive testing underway, insulation is now tested by raising the temperature to 110°F in this special room and letting the appliance run for an additional 24 hours before turning off the gas. Then technicians determine how long it takes inside temperature of the box to rise 35°F, while outside temperature remains at 100°F.

Elizabeth Sweeney Herbert directs testing activities in her role as household equipment editor.

Now the refrigerator is ready to go to work as it would in Mrs. Homemaker's kitchen. It receives a "Friday night" load (very light), then on "Saturday" the test begins with heavy market order loading. During the course of the following days, items are removed or added; a bottle of milk, a roast, vegetables, and other foods. During this time, fuel consumption and temperature, door openings, load and other factors are checked as carefully as a doctor might check a patient under observation in a hospital bed.

Tests For Gas Ranges

Gas ranges prove their worth through a series of practical tests. Previous to these, several engineering tests are run. Thermostats are checked, and input to all burners is measured to determine whether fuel is being adequately supplied. Ovens undergo thorough study, with tests of insulation and temperature control. From this point, *McCall's* staff assumes that the proof of the range is in the pudding, and further tests take a practical turn.

Pancakes are made to determine whether heat is evenly distributed by burners. Ovens and broilers are challenged by angel food cakes, roasts, broiled chicken, layer cakes, and other foods requiring exact cooking control. If these test delicacies do not turn out "just like Mother used to make" (or better), *McCall's* economists search for the reason why, by continued study of the range under observation.

Gas Dryer Testing

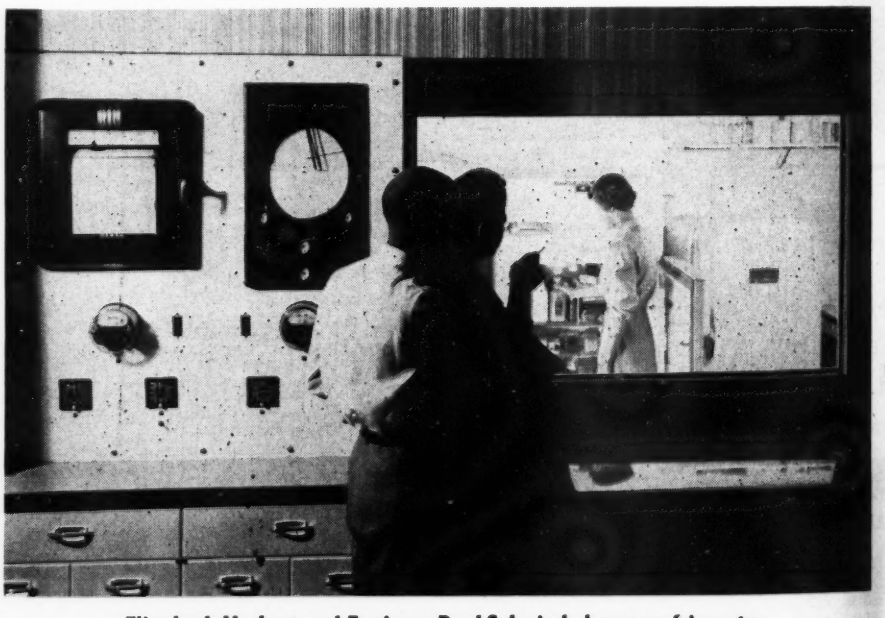
After careful installation, checking to determine mechanical characteristics is the first step of the long testing procedure. Gas input is checked when the appliance is running with no load and when the appliance is running with a full load of clothes. Drum speed is recorded. Next come a number of practical use tests with actual family wash loads. These are washed in a variety of washers. Then dryer performance is tested under different load conditions.

Rate of evaporation is also tested in the temperature control room with ambient temperature at 70°-80°F and relative humidity at 70%-80%. Each test load is first conditioned for 30 minutes in a plastic bag at the above temperatures. Loads are weighed prior to and after drying for a specified drying period. Still another test concerns dryer operating temperatures. Thermocouples are strategically placed within the dryer for both no-load and load tests. During these tests, temperatures within the dryer are recorded during the entire drying cycle.

When tests such as these are completed, *McCall's* editorial staff knows the full performance story of any given appliance. This knowledge is then applied to preparation of editorial material which will appear in the magazine. When gas range "A" appears in *McCall's* surrounded by tempting photographs of easy-to-prepare foods—not only has the range itself been thoroughly tested, but every step of every recipe has been carefully carried out in the test kitchens.

In addition, a detailed, confidential report on the operating characteristics of each appliance tested is forwarded to the manufacturer. This may contain comments on improvement of specific features and suggestions for copy to appear in the instruction booklet which will accompany the appliance into the home of the user.

As a result of this extensive testing operation, *McCall's* has been privileged to work with many of America's greatest appliance manufacturers on the development of their new products. In many instances, products are on test in *McCall's* homemaker laboratories long before they reach the public — often making their bow boasting features influenced by the knowledgeable young women who work for America's household in *McCall's* appliance test rooms.



Elizabeth Herbert and Engineer Paul Schwind observe refrigerator testing in special temperature and humidity control room where appliances undergo grueling tests under varying conditions.

Here's Proof . . . FROM THE RECORD

Titan Tankmaster Excels!

"NOT JUST ANOTHER CONTROL"

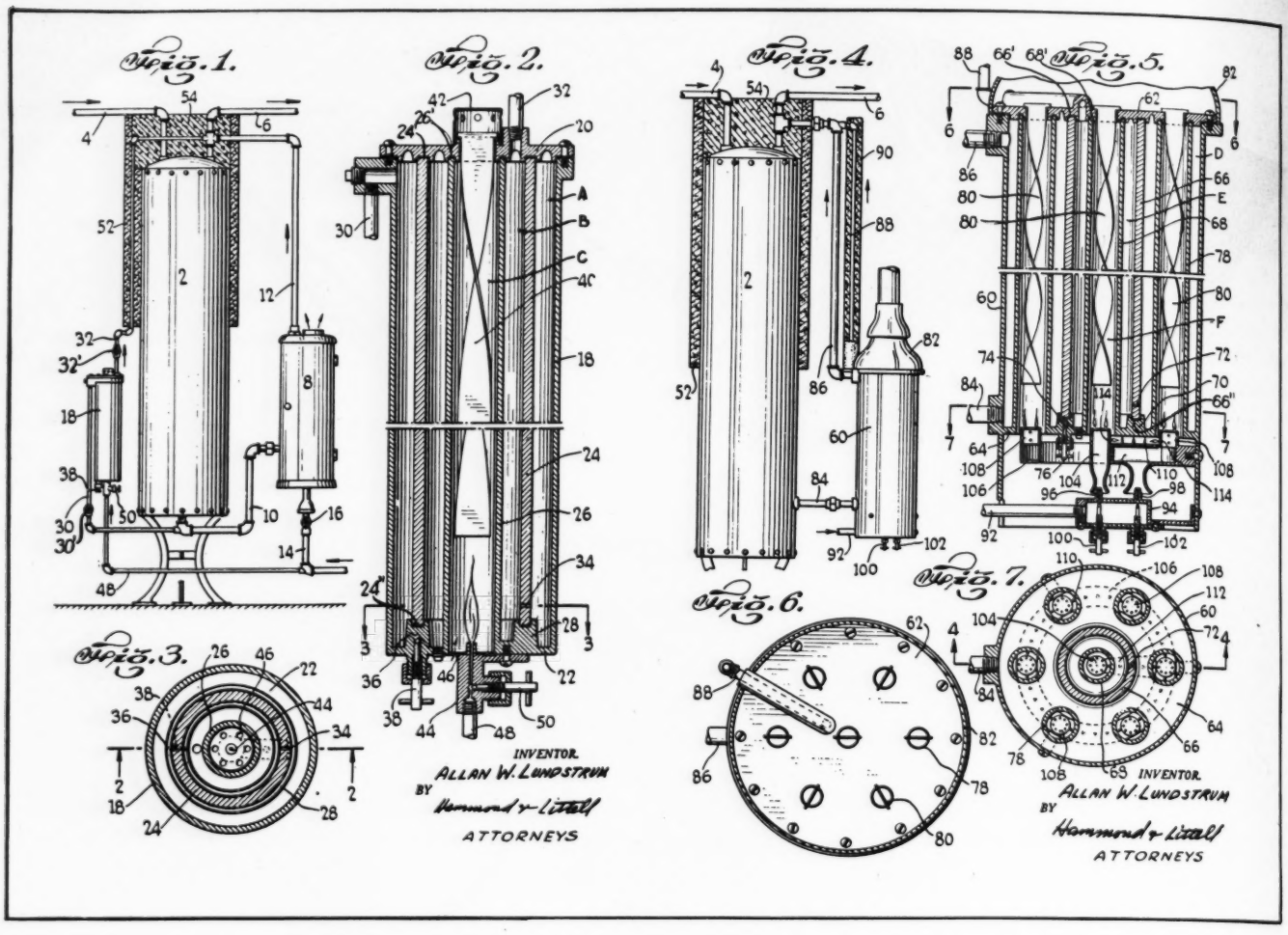
FIRST ANNIVERSARY of Titan Tankmasters in actual field service, brings forth many complimentary letters about Titan Tankmaster Performance and Dependability. Typical of such letters is one from a manufacturer who states, we quote:

> "We have approximately 1400 Tankmaster Thermostats in the field, and the salesmen in the territories where they are installed said they have not had any trouble whatsoever, which speaks very good for your Tankmaster."

EQUIP YOUR WATER HEATERS WITH TITAN TANKMASTERS AND ENJOY THE SAME SUPERIOR PERFORMANCE.

THE TITAN VALVE & MANUFACTURING COMPANY

9913 ELK AVENUE • CLEVELAND 8, OHIO



Combination Manual-Automatic Domestic Water Heater Patented

WHAT might best be described as a compromise between a manually and automatically operated domestic hot water heater has won a patent for its inventor, Allan W. Lundstrum, vice president of the Ohio Fuel Gas Co., Columbus.

The appliance is designed to cut operating costs inherent in automatic operation stemming from "rather large" standby losses but at the same time to eliminate the inconvenience of the manual water heater, and yet to retain some of the advantages of each. One of the primary objects is to "provide a method of water heating which will provide a reasonable supply of hot water at very low cost with very little manual attention."

High Efficiency Claimed

In its operation, heat is supplied to a constantly burning flame of very low input—1000 to 3000 Btu per hour. This delivers water at useable temperatures to the top of the tank after one trip through the heater. This water will stratify at the top for withdrawal. High efficiency is possible because of both the fixed input, which permits it to be designed for high efficiency, and the minimizing of standby losses, since only a small volume is stored.

The possibility of dangerous overheating of the water is prevented by leaving the lower portion of the tank completely uninsulated, or nearly so. Thus heat may be radiated at a rate equal to input, giving an equilibrium at a safe water temperature. This feature is designed to accomplish the same results as do safety controls in automatic heaters, at little cost.

The manually controlled, high recovery hot water heater operates in conjunction with the low input auxiliary to supply hot water quickly for use in emergencies.

The invention was so designed as to be installed as an auxiliary to existing non-automatic equipment (without necessitating the draining of water from the tank or cutting any water or gas pipes) or used in original installations. In the latter case, the two systems are combined so that the low input heater can act as a pilot for the high input heater.

Modification of System

Fig. 1 shows in elevation, with parts in section, one modification of the system for existing manual installations. *Fig. 2* is a vertical cross-section through the auxiliary heater of *Fig. 1*, substantially on the line 2—2 of *Fig. 3*. *Fig. 3* is a horizontal cross-section substantially on the line 3—3 of *Fig. 2*.

Fig. 4 shows in elevation, with parts in section, modification intended as original installation. *Fig. 5* is a vertical cross-section through the heater unit of *Fig. 4* on the line 4—4 in *Fig. 7*. *Figs. 6* and 7 are horizontal cross-sections on the lines 6—6 and 7—7, respectively, of *Fig. 5*.

GET THE *Inside Story*

of EMPIRE *Gas* FLOOR FURNACES

EMPIRE *Leads in* DESIGN AND ENGINEERING

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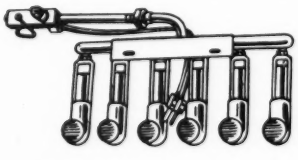

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WORLD'S LARGEST MANUFACTURER OF *Gas* FLOOR FURNACES

from: THE OHIO FUEL GAS COMPANY 99 N. FRONT ST. COLUMBUS 15, O.

William F. Smiley, Director of Information
Thomas L. Ryan, News Bureau Manager — Telephone MAin 1161

(NATURAL GAS—second of a series.)

The nat[illegible]
on it.

Ohio Fuel Tells Why There's "Shortage in the Midst of Plenty"

LIKE so many natural gas users in the country today, customers of Ohio Fuel Gas Co., Columbus, are suffering from a severe case of "shortage in the midst of plenty." But if they read their local newspapers, they should have a sympathetic understanding of the company's predicament. For through 46 local papers circulated in Ohio Fuel's territory, Bill Smiley's information department recently had an opportunity to tell the company's story, completely and objectively.

Exclusive

Public relations men and newspaper men realize that the feature article is the best tool for giving readers a rounded picture of a given subject. Day-to-day newspaper items sometimes add up only to a rather hazy, confused conception of the whats and whys of a company's operation. What with professional obstructionists receiving a full hearing in the daily press in most cities, it is often up to the company to prepare a full, complete package story if it is to fully explain its position.

So it was that when Bert A. Teeters, managing editor of the Springfield *News*, approached Thomas L. Ryan, Ohio Fuel's news bureau manager, for an article that would tell his readers "something on the gas business as it is today," Mr. Ryan and the rest of the staff decided to take the opportunity to do a real job.

Ideas Expanded

Originally, Mr. Teeters had merely wanted answers to certain questions, but after the matter had been talked over, it was agreed that a series of articles, complete with appropriate art, was needed to put the company's story across.

Elements of the four-part series that was eventually worked out included (1) supply and demand, (2) growth of long-distance pipelines, (3) underground storage, and (4) local distribution system construction.

After the series had been accepted by Mr. Teeters, Mr. Ryan obtained his endorsement of it, arranged for matting of art, and shipped it to the other papers in Ohio Fuel's service area. The response was heartening.

All told, 46 papers used the series. The Springfield *News* was the only one to use all four stories, although a number of papers used three. The final installment, which had to be prepared locally, was the least used, appearing in only five papers. A summary of results shows that 28 papers used story No. 1, 32 used story No. 2, and 19 used story No. 3.

The Springfield *News* broke the first story on Nov. 27, 1951, with the four installments running on consecutive days. The Athens *Messenger* followed two days later, Nov. 29, with the first installment and used the fourth installment Dec. 3. The articles ran as late as early January in several newspapers.

As a package, the articles were built up to prove the company's point that it was doing everything possible to meet the demand, but that supply was falling short because of the price differential so markedly favoring gas over other fuels. However, each article was so written that it could stand alone and still present a potent argument; so Ohio Fuel had the opportunity to get its story across even in those cities where only one, two, or three of the pieces were published.

The series was delivered to each of the papers by the local managers, which is standard operating procedure at Ohio Fuel. Mr. Smiley's covering letter to the managers pointed out that the first three articles could be used as written, while the fourth article might serve as a guide for a locally written article, based on information furnished to the editor by the local manager, detailing local operations and construction projects.

Appraisal of Results

In appraising results Mr. Smiley modestly admits that "we believe reaction was favorable." Not only did the series receive good play in the 46 papers, but it has also been used as reference material by many of the selected business editors and editorial writers to whom it was released. Some of the key facts have since been used in their columns and editorials.

"We believe some of the other editors who did not run the series — provided they took time to read any substantial part of the material — may have gained a little more understanding of our operations," declares Mr. Smiley. "We continue to run into people who refer to the articles."

"If we were to try to pin down any one

(Continued on Page 88)

Ohio Fuel's Four-Part Story

Installment No. 1, possibly the most important to Ohio Fuel Gas Co., told the key story of "shortage in the midst of plenty": how with gas reserves at their highest and pipelines at their biggest, the price differential and the desirability of gas are pushing demand 'way past the company's ability to meet it. While Ohio ranks fifth in population, it has more natural gas customers than any state except California and more gas househeating customers than any state except California and Texas; ranks third behind the same states in total gas deliveries; is second to California in residential volumes and in deliveries to commercial customers; and is "just about No. 1" in industrial use (excepting "field and associated" uses).

It also told of the leaping increases in demand since 1946 and the tremendous amount being spent in trying to keep pace.

Installment No. 2 told about the big pipeline system which brings gas from hundreds of miles away to feed the Ohio Fuel Gas system—Panhandle Eastern, Tennessee Gas, Texas Gas, Texas Eastern, and Transcontinental, and pointed out that Ohio Fuel customers could use almost the entire output of Texas Eastern if it didn't have to be shared with 23 other utilities en route.

It explained the certification program of FPC which necessarily delays new projects. Brief mention was also made of the company's vast underground storage projects.

Installment No. 3 developed the whole story of underground storage and its usefulness in meeting heavy winter peaks.

Installment No. 4 mapped in detail local construction jobs under way, completed, and proposed; listed costs; and familiarized readers wtih local operations and the local personnel.

As a package, the series told a big story and a glamorous one, and did it in such a way as to give the man in the street a sound, basic acquaintance with the gas industry as it looks today.

This is all you need to install PlastiPipe

The versatile flexibility of Plastic Process PlastiPipe offers a unique combination of lasting economy, uninterrupted service, and time and labor saving installation.

Photos courtesy Southern California Gas Co.

no welding apparatus required. Joints are *permanently* sealed by a solvent cement—all necessary field operations can be performed by the simple tools in a service man's kit.

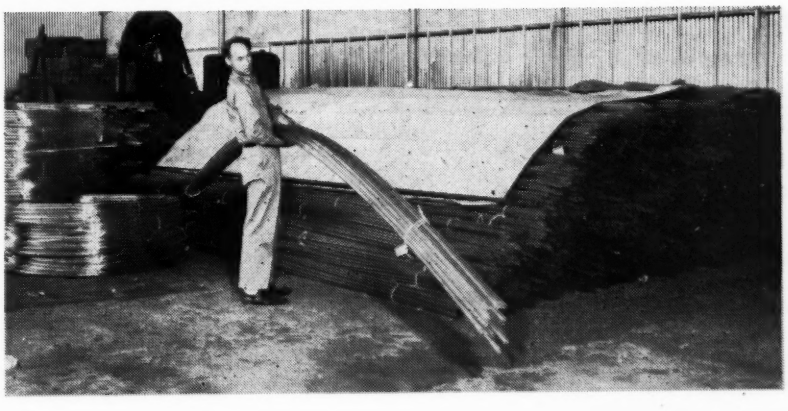
saves the expense of removing old, corroded pipe. PlastiPipe can be easily inserted into old service lines, with connections quickly made at terminals.

resists sour gases, soil deterioration, electrolytic corrosion.

facilitates flow of gas, increasing capacity over steel pipe up to 25%.

so light a 210 ft. coil weighs only about 18 lbs.

plastipipe 5/8" and 3/4" OD flexible tubing liners come in coils of 210 foot lengths. Rigid PlastiPipe comes in 1-1/16" OD in 20 foot lengths with one end belled. Other sizes upon request.



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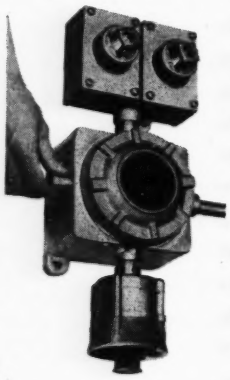
DETECT combustible GAS

INDICATE • RECORD • CONTROL

J-W Model F Indicator checks the presence of combustible gas at inaccessible locations. Aspirator bulb draws air mixture through sampling hose and probe. Meter registers combustibility instantly. Fully portable, dry-cell operated.

MODEL F



MODEL EE

J-W Models E and EE Alarms monitor fixed installations where explosive hazards may exist. For continuous operation from standard 115-v a-c line. Actuate audible or visual signals, control valves or motors. Model EE is explosion proof. Model E is for installation remote from sensing unit.

J-W Sentinel Alarm serves as a fire-danger watch-dog under conditions of special localized combustible-gas hazard — such as: welding, electrical work, tank cleaning, etc. Storage-battery operated, inbuilt charger, penetrating audible alarm.

SENTINEL

Other models available for laboratory, oil-well logging, and other specialized uses. Your inquiry is invited on designs to meet particular requirements.

Standard for over 25 years

Write for complete information

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NEWS

Financial

Arkansas Governor Orders Probe of Utilities' Books

In an unprecedented order, Gov. Sidney S. McMath of Arkansas last month directed the state public service commission to investigate the possibility of reducing some public utility company rates and forestalling certain contemplated increases.

An audit of private utility books was ordered by the governor to determine amount of waste or favoritism, if any, in construction and purchasing practices; whether contracts have been awarded to lowest bidders; "unconscionable" profits or improper practices in building and buying; and amounts charged to advertising, legal expense, contributions, travel, entertainment, and "related matters."

An investigation of legal expense will allow the governor to identify lawyer members of the state legislature who may be receiving retainer fees from utilities, it was said.

FPC Okays Two Mergers; Gets Request for a Third

Two gas company mergers were approved and one was applied for last month, involving utilities in Arizona, New Jersey, and Massachusetts.

Neither employees nor customers will be affected by the joining of Taunton (Mass.) Gas Light Co. with Brockton (Mass.) Gas Light Co. recently approved by the state department of public utilities. The new company, to be known as Brockton Taunton Gas Co., will serve 53,000 customers in 34 cities.

Merger of Arizona Edison Co. Inc. with Central Arizona Light & Power Co., both of Phoenix, was okayed by the Federal Power Commission. Central Arizona will be the surviving firm and will be known as Arizona Public Service Co. The commission issued two orders, one authorizing consolidation of the electric facilities of the two companies and the other approving transfer of the natural gas properties subject to FPC jurisdiction.

The plan will result in reduced operating costs, including a $150,000 a year saving in office expense alone, the firms reported. Henry B. Sargent, top Calapco executive, heads the new company as president and general manager.

In compliance with an SEC order, Jersey Central Power & Light Co., Asbury Park, N. J., has applied to the FPC for authority to sell its natural gas facilities to County Gas Co., Atlantic Highlands, N. J. Overall cost of the proposed acquisition is $16,467,689.

Properties consist of Jersey Central's coast, northern, and southern divisions, which serve manufactured, mixed, and natural gas to some 84 communities.

Ohio Fuel . . .

(Continued from Page 86)

basic reason for the broad acceptance of the material, it would probably be this: It covered a newsworthy subject which was timely and, to the best of our ability, presented a good many little-known but significant facts about a typical gas company's operations. We emphasized the Ohio angle in the series, leading from that in Ohio Fuel's activities . . . Certainly, in passing, the series told why we had been forced to request Public Utilities Commission orders restricting new heating installations, but it did that only as a side issue. The main point was that it stressed the actual size and scope of the operations of a gas company doing its best to meet today's demand for the nation's 'most wanted' fuel."

Numerous Rate Increases Effective Under Bond

Upon posting of bond with FPC, a number of rate increases went into effect in February, subject to refunds which might be subsequently ordered by the commission.

A $5.7 million wholesale increase by Hope Natural Gas Co., Clarksburg, W. Va., became effective Feb. 1. Six interstate customers are affected: East Ohio Gas Co., Cleveland; Peoples Natural Gas Co., New York State Natural Gas Corp., and Manufacturers Light & Heat Co., all of Pittsburgh; River Gas Co., Clarksburg; and Mount Morris (Pa.) Gas Co.

On Feb. 6, United Fuel Gas Co., Charleston, put into effect an annual $6.5 million rate hike, and Ohio Fuel Gas Co., Columbus, followed on Feb. 11 with a $1,270,000 increase. Both companies are subsidiaries of the Columbia Gas System. Ohio Fuel's new rates apply to wholesale purchasers whose market areas extend throughout most of Ohio, while United Fuel's affect Atlantic Seaboard Corp. and Central Kentucky Natural Gas Co., Charleston; Manufacturers Light & Heat Co., Pittsburgh; Portsmouth (Ohio) Gas Co.; and Ohio Fuel.

Central Kentucky Natural, in turn, on Feb. 17 put into effect a rate increase of its own. Amounting to $1,406,000, it will be passed on to Cincinnati Gas & Electric Co.; Frankfort Kentucky Natural Gas Co., Lexington; Limestone Gas Co., Maysville, Ky.; and Union Light Heat Power Co., Covington, Ky.

A suspended $21.4 million increase by Panhandle Eastern Pipe Line Co., Kansas City, became effective Feb. 20. FPC directed Panhandle to keep accurate accounts of all amounts received and, in a concurrent order, postponed the date for resumption of hearings on the rate case from March 11 to April 22. Hearings were recessed Dec. 11.

FPC has suspended the second part of United Gas Pipe Line Co.'s plan which would raise the cost of gas delivered to

Here's proof that ULTRAMATIC Caloric®

...the last word in AUTOMATIC COOKING... has ALL the features women want!

In a nation-wide survey among Caloric Gas Range owners, thousands of women were asked—

"WHAT FEATURES DO YOU BELIEVE MIGHT BE ADDED TO THE CALORIC?"

74.6%

COULD NOT THINK OF A SINGLE NEW FEATURE

Get into the CALORIC picture in 1952

Again in 1952, Caloric national advertising will be the largest, strongest and most consistent in the entire range industry. More than 200 million selling messages in national and rural magazines will be backing up every Caloric Dealer. Get in step with this giant promotion effort. Decide now that it's *"Caloric for You—in '52."*

Guaranteed by Good Housekeeping

CALORIC STOVE CORPORATION, TOPTON, PENNA., *Gas Ranges Exclusively*

AMERICA'S EASIEST RANGES TO KEEP CLEAN

Southern Natural Gas Co., Birmingham, by about $2 million annually. The commission at the same time consolidated the proceeding with the earlier suspension of the first part of the proposal and scheduled a hearing which was to begin last month.

United, which under its present schedule sells about 115 MMcf daily to Southern Natural, proposes to reduce the sales to 60 MMcf/d and then enter an agreement whereby it would transport an additional 55 MMcf for delivery to Southern Natural. The latter company would obtain the 55 MMcf from Southern Production Co., which has been selling the gas to United.

In Buffalo, Republic Light Heat & Power Co. Inc. has asked the New York Public Service Commission for permission to put into effect a uniform rate for customers using manufactured gas, replacing seven different existing rates. The plan would result in an increase for 21,000 customers and a reduction for 11,250 others. Increases would range to 10%, depending upon the area.

The Kansas Corporation Commission, meanwhile, has taken under advisement an application by Kansas Power & Light Co., Topeka, for a new rate designed to increase annual revenue by $660,000. The company is seeking a system-wide increase in industrial rates and a hike in domestic charges in 15 central and southwestern Kansas towns.

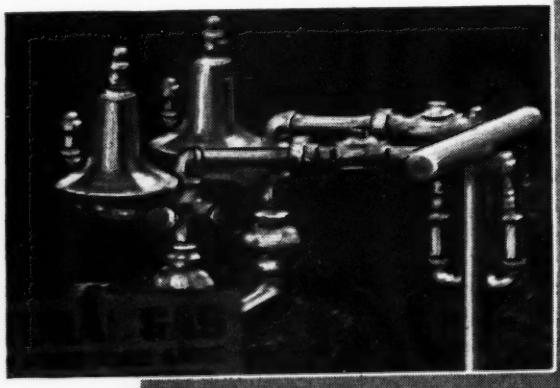
Claude L. Flower, associate engineer of the Colorado Public Service Commission, testifying in behalf of the protesting Kansas cities, said Kansas Power & Light showed an unreasonable unaccounted-for figure for 1951. He contended that the rate increase sought should be reduced by $372,328.

To permit an adequate return in the face of rising costs, Consumers Power Co., Jackson, Mich., has petitioned the state public service commission for permission to raise its rates. The increase would reflect higher rates being charged by Michigan Gas Storage Co., its subsidiary and supplier.

In a similar request, Peoples Gas Light & Coke Co., Chicago, will ask the state commerce commission for higher rates on gas for househeating. The plan was disclosed in the company's annual report to stockholders, but specific details had not been worked out.

On April 1, consumers in Charlottsville, Va. were to begin paying about 10% less for gas, following an ordinance passed by the city council. The new rate will reduce estimated profit for 1952 operations by about $31,000, the council reported. The city-owned gas department showed an excess of receipts over disbursements last year of $52,000.

A WIDER RANGE
... of Delivery Pressure Control



REYNOLDS HIGH PRESSURE LINE REGULATORS in parallel hookup have an increased range of capacity as well as a wider range of delivery pressure control. This also provides greater margin for emergencies. On inlet pressure the range is up to 650 pounds. For outlet pressure, this unit assures absolutely accurate and dependable control from 2 to 100 pounds. This variance in outlet pressure is made by use of different sizes of diaphram cases and further flexibility in the spring type is possible by use of different strength springs.

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Reynolds Gas Regulator Co.
ANDERSON, INDIANA, U. S. A.

GAS CONTROL SINCE 1892

Mississippi Valley Gas Co. Acquisition Authorized

Mississippi Valley Gas Co., Jackson, has been authorized by the Federal Power Commission to acquire and operate natural gas pipeline facilities of Mississippi Power & Light Co., also of Jackson.

Under the agreement, Mississippi Valley would supply Mississippi Power with the gas requested for use in its electric generating stations. The condition was made however, that Mississippi Valley is not to curtail or interrupt service to its domestic or commercial customers in order to provide such gas to Mississippi Power or others.

The facilities acquired include 1199 miles of Mississippi Power's existing gas system in 16 Mississippi counties. In addition, Mississippi Valley will operate 242 miles of 3-in. line which Mississippi Power now leases from the towns of Carthage, Carrollton, and North Carrollton, and the Bolivar, Deer Creek, Delta, and De Soto Natural Gas Districts.

Basic purchase price of the facilities is $11,128,151.

January Gas Sales Up 10%

According to an American Gas Assn. report, January gas sales totaled 5645 million therms, an increase of 10% over January 1950. Sales reported for the 12 months ended Jan. 31, 1952 rose 14% over the same period a year earlier.

For the month, natural gas sales were up 10.8% over January last year, manufactured declined 34%, and mixed rose 50.4%. Twelve-month figures showed natural up 15.6%, manufactured down 24.6%, and mixed up 32.2%.

Rhode Island Firm Proposed

A bill to incorporate the Roger Williams Gas Co. to distribute natural gas in the Pawtuxet valley area of Rhode Island has been introduced in the state legislature for the second consecutive year. A similar bill, along with one in opposition to it, died in the general assembly last year.

are you on the bandwagon?

What every woman wants

A COOLER KITCHEN!

The tiny, EconoMatic pin-point pilot is something she understands—smaller pilot, cooler range.

SAVE TIME, SAVE FUSS!

Another of her dreams—to throw away the matches. Oven and top burners light automatically.

COOKING AT ITS BEST!

In addition to EconoMatic, the features that make HARDWICK cooking performance famous make it easier to sell the range!

New sales records are being written on a pin-point!

A new advance in gas cooking—a new high in selling high-unit automatic ranges. HARDWICK's used to successes, but this feature has out-succeeded all others! Econo-Matic is the biggest sales-clincher since the invention of automatic oven lighting. *Tie in with dramatic ads in Woman's Home Companion, Ladies' Home Journal* and other leading national magazines. Capitalize on a feature that's *easy, simple, and quick* to sell.

only HARDWICK has EconoMatic pin-point pilot lighting

HARDWICK STOVE COMPANY • Cleveland, Tennessee

Proposed by Rep. Gerard DiFiore, the bill would empower the new company to set up a gas plant with all necessary lines to serve West Warwick, Coventry, West Greenwich, Scituate, and part of Cranston. It could dig up streets, under proper supervision, in order to lay pipes and repair them.

New Construction

United Gas Will Add Wing to Office Building

A new 10-story wing costing $2.5 million will be added to the United Gas Co. office building in Shreveport, according to an announcement made recently by N. C. McGowen, president of the company. Authorization for use of critical material has been received from the office of the petroleum administrator for defense.

Construction will begin immediately and approximately one year will be required to complete the wing. The new structure will increase the available office space of the present building by about two-thirds. The present building was completed in February 1940, at a time when only 550 employees were quartered in the building. After completion of the new wing, 1000 employees will occupy the building.

Neild-Somdal Associates, Shreveport, are architects and the prime contractor is the Werner Co., also of Shreveport.

CHANGING OVER?

then consider CARBOSEAL

Trade-Mark

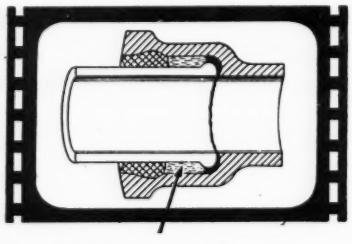
ANTI-LEAK

for dried-out packing.

The jute and hemp packing of bell-and-spigot joints dries out rapidly in dry manufactured or natural gas, propane or butane systems. The result is increased gas leakage, vegetation damage, hazardous conditions, and costly maintenance of dry gas mains. By introducing CARBOSEAL Anti-Leak into your mains, you can save money, reduce dust problems, and get as high as 100% reduction in leakage.

CARBOSEAL Anti-Leak reaches every joint. It swells the jute fibers as much as 44%, and keeps bell-and-spigot joints gas-tight indefinitely. It also wets down rust and dirt in the mains and reduces service calls due to pilot outages.

With CARBOSEAL Anti-Leak, you don't have to uncover every joint or keep adding oil or water vapor to your gas. Where mains are graded, CARBOSEAL Anti-Leak is poured in at high points. As much as 400 feet of level main can be treated through one opening using a hose and nozzle. The average cost to treat one mile of 3-inch equivalent main is less than $100 for the CARBOSEAL Anti-Leak required. Joints treated with CARBOSEAL Anti-Leak 17 years ago are still gas-tight today with no re-treatments necessary. Get the facts by writing for our booklet, F-4506.



You can see exactly how CARBOSEAL Anti-Leak works by writing for our 16 mm. color motion picture which will be loaned to you without charge—Address:

CARBOSEAL ANTI-LEAK

Carbide and Carbon Chemicals Company

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"Carboseal" is a registered trade-mark of Union Carbide and Carbon Corporation.

According to Mr. McGowen, United Gas has expanded considerably since 1951. Its operating revenues have increased from $44.7 million to $125.7 million; the value of its properties has increased from $276.8 million to $506.9 million; and its transmission mileage has increased from 11,260 to 18,500.

Pittsburgh Line Completed

Manufacturers Light & Heat Co., Pittsburgh, recently completed construction of three miles of high pressure gas line along Ohio River Blvd. in that city, a project costing $400,000.

Rich & Co., Bradford, Pa., was the general contractor for the job, which was started in October. The new line serving the Ohio river communities has three times the capacity of the old line which will continue to operate but as a medium pressure artery. Plans for an eventual extension of the line into Glenfield are now in the drawing board stage.

O. O. Todd, district manager of the gas company, voiced appreciation for the cooperation of residents during the inconvenience caused by the construction.

Lab Name Honors Director

Rochester Gas & Electric Corp.'s new chemical and gas utilization laboratory will be named after the late Jesse Yeaw, director of the existing laboratory until his death in August.

The new laboratory will be located at the company's East station. It will cost $115,000.

Yeaw had worked in the company's laboratory for 25 years and played a leading role in many research projects dealing with the analysis of gases, mixing methods, and all varieties of distributing and transmitting equipment.

Miscellany

Utilities Cited by NSC For Safety Records

Gas and electric utilities participating in the annual safety contest of the National Safety Council reported 6% fewer injuries in 1951 than during 1950. Total exposure was 608,199,000 hours, 14% higher than that reported at the end of 1950, while number of injuries was 5593, up 7%. This brought the average frequency rate of accidents down 6%.

Combination gas and electric utilities showed a 13% reduction in frequency rate from the previous year, gas utilities rose 3%, and electric utilities declined 2%.

First place winners in the combination division included Consolidated Gas Electric Light & Power Co. of Baltimore; Wisconsin Power & Light Co., Madison; Worcester (Mass.) County Electric Co.; Northern Berkshire Gas Co., North Adams, Mass.; and Beverly (Mass.) Gas & Electric Co.

In the gas division, top honors went to Peoples Natural Gas Co., Pittsburgh; Pittsburgh & West Virginia Gas Co., Pittsburgh; Canadian River Gas Co., Amarillo; Water & Gas Dept., Duluth, Minn.; Arlington

An Informed Industry is a Strong Industry!

Today, the challenge of competition can best be met by an informed, *educated* personnel that *fights with modern facts.* And the best way you can give your up-and-coming executives a capsuled, fact-crammed course on the modern, marvelous Gas Industry is at the AGA Convention discussions on newest methods, newest processes, newest equipment and newest appliances.

Invest in your PERSONNEL! Send more of them to your Industry's convention and exposition.

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Here, under one roof, will be assembled a display of the finest appliances, machinery and methods. Here the keenest minds will discuss the outstanding problems confronting our Industry today. Here *is* the Gas Industry in all its might and glory . . . a source of inspiration and education for all.

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Who Stopped A Leak in a Dike With His Thumb To Save A Nation

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put their *fingers* on your gas leaks and SAVE gas — SAVE $ $, Improve Public Relations

Don't Delay Order a Heath Survey Today

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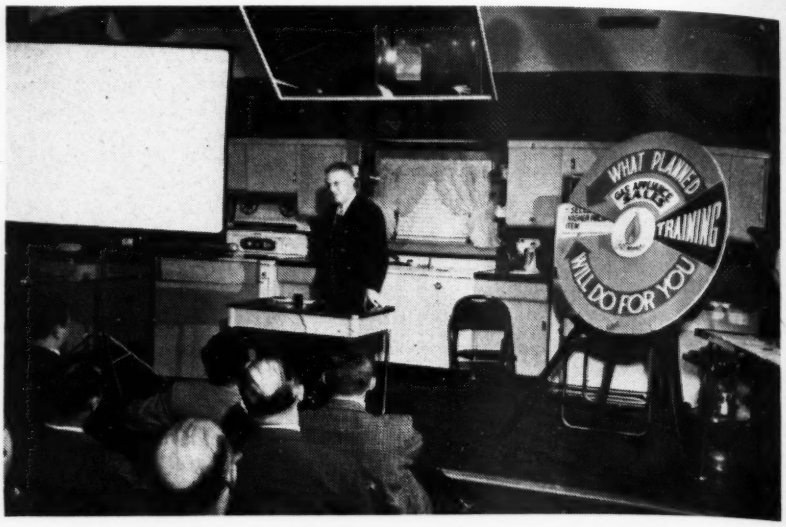
"You Can't Sell Gas That Leaked Out"



SRO Sign Out for Gas Appliance Sales Course

A waiting list already exists for the gas appliance sales courses recently initiated by City College of New York. Two eight-week pilot courses now under way are to serve as a basis for a national sales training program to be conducted as a cooperative effort of the Assn. of University Evening Colleges, GAMA, and AGA.

In the photograph, Sol W. Weill, eastern manager for Geo. D. Roper Corp., addresses students at a session held at Public Service Electric & Gas Co. in Newark. To provide for maximum individual participation, classes are limited to 30 persons.

Ten universities have announced their intention of offering courses under the program, and an upstate New York utility has indicated that it will subscribe to the course for its employees and dealers.

(Mass.) Gas Light Co.; Salem (Mass.) Gas Light Co.; Empire Southern Gas Co., Brady, Texas; and Wachusett Gas Co., Leominster, Mass.

East Ohio Gas Co., Cleveland, and Nashville (Tenn.) Gas & Heating Co. won second place honors in the gas division, and the Columbus Group, Columbia Gas System, and Colorado Interstate Gas Co., Colorado Springs, won third place awards.

Honorable mention certificates were presented, in the combination group, to Northern Indiana Public Service Co., Hammond; Wisconsin Public Service Corp., Milwaukee; Northwestern Public Service Co., Huron, S. D.; and Wisconsin Michigan Power Co., Appleton, Wis. In the gas division, Ohio Fuel Gas Co., Columbus; Lone Star Gas Co.'s Forth Worth Division of Distribution; and Northampton (Mass.) Gas Light Co. received honorable mention.

"Colorado Story" Honored

In recognition of its efforts to stimulate interest in the early history of Colorado and in the principles on which the state was founded, Public Service Co. of Colorado, Denver, received the highest 1951 Freedoms Foundation award at Valley Forge, Pa., in late February.

John E. Loiseau, president of the company, accepted the award from Dr. Robert A. Millikan.

The prize-winning exhibition was "The Colorado Story," a gallery display of 50 panels depicting Colorado's progress from pre-historic days until statehood was achieved in 1876.

Gas Odorization Started

Peoples Natural Gas Co., Pittsburgh, has begun the odorization of gas being served in its Midland, Ohioview, and Industry distribution areas. On a gradual district-by-district basis, the company will add odorant to the gas served to all its 219,000 customers in western Pennsylvania.

Facilities for adding Calodorant C, manufactured by Oronite Chemical Co., were installed last month. The odorant was described as having a petroleum smell characteristic of gas in old Pennsylvania and West Virginia gas fields.

New AGA Lab Fee Schedule

Effective April 1, a new fee schedule for inspection of appliances by the AGA Laboratories will go into effect. The net increase amounts to between 15% and 20% more than fees which have been in effect since November 1949.

The April date was considered equitable for all manufacturers because all annual inspections for approval renewals for the current year will have been completed by that time.

"Incentive Library" Opened

To assist sales executives and businessmen in researching the methods, ideas, and promotion materials used by successful campaign sponsors, Cappel, MacDonald & Co.,

(Continued on Page 96)

CALENDAR

APRIL

Florida-Georgia Gas Assn. Annual Convention — Soreno hotel, St. Petersburg, Fla., April 3-5.

Maryland Utilities Assn. Annual Convention — Lord Baltimore hotel, Baltimore, April 4.

Eastern Natural Gas Regional Sales Conference, Residential Gas Section — Hotel William Penn, Pittsburgh, April 7-8.

National Conference of Electric and Gas Utility Accountants — Hotel Commodore, New York, April 7-9.

AGA Distribution, Motor Vehicles, and Corrosion Conference — Benjamin Franklin hotel, Philadelphia, April 7-10.

AGA Sales Conference on Industrial and Commercial Gas — Netherland Plaza hotel, Cincinnati, April 16-18.

Mid-West Regional Gas Sales Conference — Edgewater Beach hotel, Chicago, April 21-23.

New England Hotel & Restaurant Exposition—Hotel Statler, Boston, April 23-25.

Indiana Gas Assn. Annual Meeting — French Lick Springs hotel, French Lick, Ind., April 24-25.

Southern Gas Assn. Annual Convention—Galveston, April 28-30.

MAY

AGA Commercial Gas School — Chicago, May 5-9.

National Restaurant Exposition — Navy Pier, Chicago, May 5-9.

Public Utilities Advertising Assn.—Hotel Radisson, Minneapolis, May 8-9.

AGA Natural Gas Department Spring Meeting—Biltmore hotel, Los Angeles, May 12-13.

Pennsylvania Gas Assn. — Wernersville, Pa., May 13-15.

Gas Appliance Manufacturers Assn. Annual Meeting — The Broadmoor, Colorado Springs, May 21-23.

AGA Production and Chemical Conference —Hotel New Yorker, New York, May 26-28.

Southwestern Gas Measurement Short Course—University of Oklahoma, Norman, May 27-29.

Short Course in Gas Technology—Texas College of Arts & Industries, Kingsville, May 28-30.

JUNE

AGA Research and Utilization Conference —Hotel Statler, Cleveland, June 5-6.

Canadian Gas Assn.—Chateau Frontenac, Quebec City, Quebec, June 8-12.

Michigan Gas Assn. Annual Meeting — Grand hotel, Mackinac Island, June 23-24.

National Retail Credit Assn. 38th International Consumer Credit Conference—Statler hotel, Washington, D. C., June 23-26.

SEPTEMBER

Pacific Coast Gas Assn. Annual Meeting —Ambassador hotel, Los Angeles, Sept. 3-5.

New Jersey Gas Assn. Annual Meeting—Monmouth hotel, Spring Lake, N. J., Sept. 12.

OCTOBER

Independent Natural Gas Assn. of America Annaul Meeting — Fontenelle hotel, Omaha, Neb., Oct. 6.

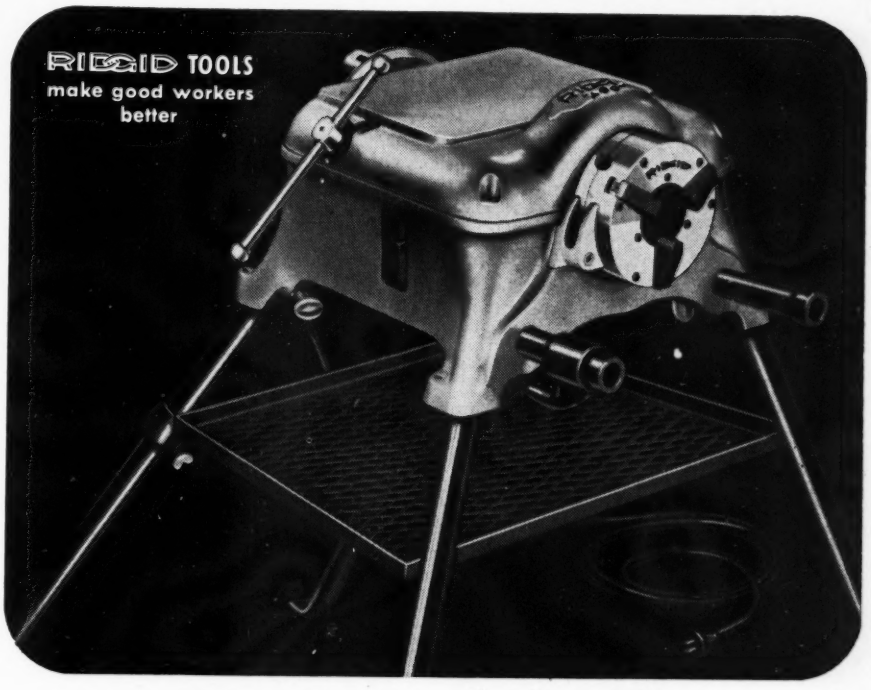
California Natural Gasoline Assn. Fall Meeting—Ambassador hotel, Los Angeles, Oct. 10-11.

American Gas Assn. Annual Convention—Atlantic City, N. J., Oct. 27-30.

NOVEMBER

American Petroleum Institute Annual Meeting—Chicago, Nov. 10-13.

WHY SKILLED PIPE FITTERS Demand RIDGID "400" PORTABLE POWER DRIVE



RIDGID *"400"—bench model or stand with tray, capacity ⅛" to 2"—to 12" with geared tools.*

Time-and-work-saving power for hand threaders, cutters, reamers

★ Extra light-weight unit—one man can handle it.

★ Lots of power—universal motor, forward, reverse, won't bog down on large pipe.

★ RIDGID design 3-jaw chuck, chuck wrench ejector; self-centering workholder in rear turns with pipe.

★ Sealed-in lubrication—no oil to spill.

★ See the remarkable "400" at your Supply House!

THE RIDGE TOOL COMPANY • ELYRIA, OHIO

★★★ RIDGID Work-Saver Pipe Tools ★★★

(Continued from Page 94)

merchandise incentive firm, has opened an "incentive library" in New York City. The new business reference facility is located in the company's eastern offices.

A compilation in volume form of industry case histories, tested merchandise prize plans, campaign themes and rules is presented and, in addition, the library contains carefully selected information and tested programs taken from the firm's file of incentive programs.

Tokyo Gas Deposit Found

A survey just completed by the Japanese Economic Stabilization Board estimates the potential of a natural gas deposit beneath the city of Tokyo at 52 billion cu yd. The prefectural government hopes to solve the fuel problems of the city's 5 million residents by exploiting this supply.

American gas experts say this would be a sizeable field—about one-third that of California's Rio Vista field at the time of its discovery. The discovery well, drilled in March 1951, hit gas and warm salt water at 1900 ft.

Insurance Benefits Added

On March 1 four new benefits to employees were added to Columbia Gas System's group life insurance plan. The changes increased total coverage from $31 million to $37 million.

Improvements in the 23-year-old contributory group plan, participated in by 96% of eligible Columbia employees, include (1) increased coverage, which is based on salary; (2) more frequent changes in the amount of insurance carried by the employee; (3) shorter waiting period for eligibility; and (4) greater maximum coverage.

Insurance equivalent to 1½ years' pay will now be carried by the average employee.

Peerless
The fine work done on such masterpieces as this pitcher by Cellini has its modern counterpart in the painstaking care given to Welsbach-Kitson precision manufacture . . . true built-in quality. Every day, the constantly increasing list of satisfied users bears witness to the quality, economy and dependability of Welsbach-Kitson specialties. Write now for catalog and price list.
Benvenuto Cellini
G-308
All Brass Roundway Lever Handle Main Gas Control Valve with Pilot Outlet
(G-308-D with Double Pilot Outlets)
G-501-R
Iron Body Flat Head Brass Plug Gas Stop with Recessed Ends
G-501
Iron Body Flat Head Brass Plug Gas Stop
WELSBACH
G-515
Iron Body Lock Wing Brass Plug Gas Stop
QUALITY ECONOMY DEPENDABILITY
The WELSBACH CORPORATION
KITSON DIVISION
1500 Walnut Street
Philadelphia 2, Pa.

Miscellaneous

During the period Aug. 15-Dec. 15, the territory served by Hartford (Conn.) Gas Co. will be converted to 800-Btu, .50 sp gr gas. At present, the 66,000 customers in the territory are receiving 530-Btu, .60 sp gr gas. The area includes Hartford and East and West Hartford, Wethersfield, Glastonbury, Bloomfield, and Manchester.

University of Colorado's college of engineering will conduct its third annual training course in statistical quality control during June 17 to 27. John F. Wagner, assistant professor of applied mathematics, will be in charge of the course.

Regulation

Lack of Fee Sinks Big Suit

Mondakota Gas Co., Billings, Mont. firm which was appealing a Nov. 8, 1951 dismissal of its $30 million damage suit against Montana-Dakota Utilities Co., Minneapolis, had its appeal thrown out recently because of failure to pay a $5 filing fee on time.

The Billings company claimed that Montana-Dakota violated the Natural Gas and Sherman Anti-trust Acts by refusing to serve as a common carrier for gas from fields in Montana and North Dakota from December 1941 to April 1949.

The ninth federal court of appeals ruled that the clerk of the district court in Great Falls, Mont. where the suit was filed was under no obligation to file the notice of appeal until the fee was paid.

Relocation Awards Planned

Senate bill 2585, recently introduced by Senator McKellar (D-Tenn.), would amend laws relating to the construction of federal aid highways to provide for reimbursement to all public utilities, in part from federal funds, for the cost of relocating utility facilities necessitated by highway construction.

The bill was referred to the committee on public works. A companion bill has been introduced in the House, and hearings were tentatively scheduled to get under way in March.

Defense Plants Get Gas

PAD has directed two utilities to furnish natural gas to six defense plants in Pennsylvania and West Virginia.

Natural Gas Co. of West Virginia must furnish 300 Mcf/d to Continental Boundary & Machine Co., Wheeling, W. Va., and Manufacturers Light & Heat Co. must supply

it's 5 to 11

ORONITE CAN GIVE YOU GAS ODORIZATION HELP WHEN YOU NEED IT

With Oronite you don't have to fit your equipment to the odorant. We can supply the exact odorant to fit your operating conditions and odorization needs.

Oronite was *first* to make a commercial gas odorant, *first* to realize that no one type of odorant is suitable for all circumstances. That's why Oronite offers you a choice of *five* gas odorants—each time-tested to do the job.

Our wide experience in gas odorants is at your disposal. Just contact the Oronite office nearest you.

ORONITE CHEMICAL COMPANY

38 SANSOME STREET, SAN FRANCISCO 4, CALIF. STANDARD OIL BLDG., LOS ANGELES 15, CALIF.
30 ROCKEFELLER PLAZA, NEW YORK 20, N.Y. 600 S. MICHIGAN AVENUE, CHICAGO 5, ILL.
MERCANTILE SECURITIES BLDG., DALLAS 1, TEXAS 2383

ORONITE CHEMICAL COMPANY

THE NAME CHEMICALS

1. "CALODORANT"

THE NORMAC BELL JOINT CLAMP

Solves Your Joint Repair Problems • Quick • Easy • Permanent

Installed in small pavement openings. Available in all standard sizes from 3" to 12". A simple set of tools cleans the joint, installs the clamp . . . often in only a quarter of an hour. SAVES TIME. SAVES MONEY and the repair is permanent. Designed for all conditions particularly where pavement repair costs are prohibitive. Such small opening repairs are scarcely noticeable when pavement is replaced.

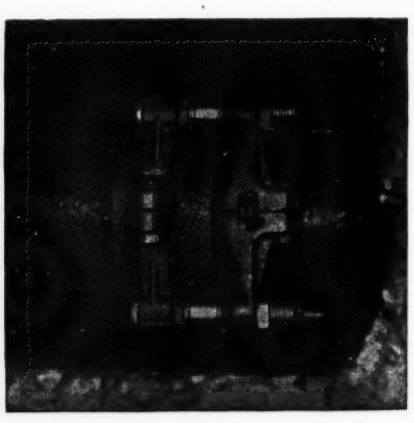
Normac Clamps can be installed in large as well as small openings.

Norton-McMurray hold definite leadership in the development of methods for installation and rehabilitation work through small openings. We welcome the opportunity to help solve a problem you may have—tell us about it.

Write for our catalog describing our complete line of

COUPLINGS . . . FITTINGS . . . SERVICE TEES and ELLS . . . SLEEVES . . . COMPRESSION-END COCKS . . . METER BARS and BRASS FITTINGS for copper pipe.

6 inch Normac Clamp being lowered into hole for installation



6 inch Normac Clamp in service after installation

NORTON-McMURRAY MFG. CO.

122 SOUTH MICHIGAN AVENUE • CHICAGO 3, ILLINOIS

Method and product covered by U. S. Patents, Nos. 2,163,261 and 2,178,286.

the following Pennsylvania companies: Continental Boundary & Machine, Coraopolis, 500 Mcf/d; Pittsburgh Forging Co., Coraopolis, 372 Mcf/d; Heppenstall Co., New Brighton, 67 Mcf/d; Wyckoff Steel Co., Ambridge, 135 Mcf/d; and National Tube Co., Elwood City, 1025 Mcf/d.

Both utilities maintain headquarters in Pittsburgh.

Regulatory Newsnotes

FPC scheduled an April 4 hearing on the application of Citizens Gas Co., Tuscola, Ill. for an order by the commission disclaiming jurisdiction over proposed construction of pipeline facilities to serve Bemont and Lovington, Ill. Citizens wants to build two short lines to connections with Texas Illinois Natural Gas Pipe Line Co.'s system. FPC has approved the sales of gas by Texas Illinois, but the authorization was conditioned upon Citizens' obtaining FPC permission or establishing exemption from regulation.

On May 28 a public FPC hearing will get under way in Washington, D. C. on the complaint of the city of Hastings, Neb. against Kansas-Nebraska Natural Gas Co. Inc., Phillipsburg, Kan. The city alleges that a restriction contained in Kansas-Nebraska's rate schedule is unlawful in that it provides that the schedule shall not apply to gas used in the city's electric generating stations.

Manufacturers

Dresser Begins Series of Management Training Meets

An executive management training conference, the first of a series to be held quarterly, last month attracted top management of Dresser Industries Inc. to the Town House, Los Angeles, for panel discussions by representatives of 10 companies operating under the company's management.

To provide this trained force, H. N. Mallon, Dresser president, appointed this executive training committee: Richard P. Brown, personnel director; Thomas L. Moody, di-

These panel group members at the Dresser training conference are (l. to r.) R. E. Reimer, of the company's Dallas headquarters; H. P. Boncher, vice president and general manager of Dresser Manufacturing Div., Bradford, Pa.; H. N. Mallon, president; R. P. Brown, director of personnel and organization planning; and J. B. O'Connor, executive vice president.

The job of planning a well rounded sales department is claiming the attention of (l. to r.) D. A. Johann and R. R. Newquist, Roots-Connersville Blower Corp., Connersville, Ind.; H. Z. Hight, Dresser Manufacturing Div., Bradford, Pa.; (back row) Max B. Campbell, Security Engineering Co. Inc., Whittier, Calif.; and A. E. Harvey, Stacey Bros. Div., Dresser Stacey Co., Cincinnati.

rector of industrial relations; and Arthur Weis, president of Pacific Pumps Inc., Huntington Park, Calif. subsidiary. Under the chairmanship of H. P. Boncher, vice president, this committee reviewed the research and executive training programs of 60 national companies before formulating a plan.

Panel discussions during the three-day Los Angeles meeting included "Executive Training and Development," "Can Salesmen Be Trained?" "How to Evaluate Sales Applicants and Salesmen in Your Employ," and "Organization Planning of a Well-Rounded Sales Department."

Servel Adds Four Agents

Four new distributors of refrigerators and water heaters have been appointed by Servel Inc., Evansville, Ind.

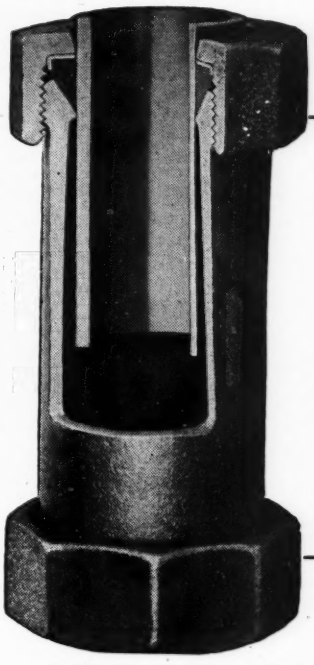
Appliance Wholesalers Inc., Portland, Maine will cover Maine and Coos and Carroll counties in New Hampshire. Other distributors and their territories are Emerson Radio of Westchester Inc., White Plains, N. Y.—Westchester and Putnam counties in New York; General Utilities Corp., Milwaukee—48 counties in eastern and southern Wisconsin and 12 counties in upper Michigan; and Hart-Greer Inc., Birmingham—Alabama and 10 counties in Florida.

In addition, Cook Appliances Inc., Minneapolis, has had its territory enlarged to include 23 counties in northwestern Wisconsin. The firm formerly covered Minnesota, North Dakota, and South Dakota.

Plastic Tubing Starred

Plastic tubing such as is used for gas service piping was one of the stars of the show when the National Plastics Exposition opened in Philadelphia March 11.

Tennessee Eastman Co., plastics materials manufacturer, brought an extruder from its Kingsport, Tenn. plant to produce 4-in. pipe on full production scale during the four-day show.



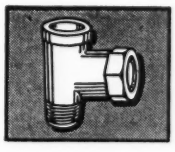
NORMAC

Couplings, Sleeves and Fittings

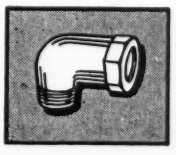
for maximum deflection, ease of "stabbing," complete confinement of the rubber!

So close are "Normac" rubbers confined at the gasket tip that possibility of flow is reduced almost to "nil." These couplings, sleeves and fittings . . . approved by gas utility men across the country for their time-saving features, ease of handling and dependable service . . . are available in a complete range of sizes. Made from air furnace malleable iron they provide greater wall thickness than pipe on which used.

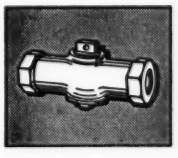
NORMAC COUPLINGS are made with 5" centers in all sizes. NORMAC SLEEVES are identical in design except that they are identical in design except that they are made with 10" centers. Nuts and gaskets are interchangeable.



Compression-End Service "Tee"—First fitting of this type ever produced with full coupling depth and special threads on male end to prevent dropping into old hand taps when used to replace standard threaded fittings.



Compression-End Service "Ell" — Extra depth makes it possible to "stab" pipe into stops and without measuring, pull back a safe distance to allow ultimate deflection eliminating possibility of strain against tap in main.



Compression-End Iron Body Brass Core Service Stopcocks—End the necessity of threading on the job plus the elimination of the threads themselves—combining all the advantages of NORMAC COUPLINGS and the best in stopcock design. 2½" coupling depth on each end.

Normac Brass Fittings Developed in 1939 for Use with Copper Tubing—Our complete line of brass fittings can be used either on new installations or where copper is run through old steel pipe in large or small openings. The center to end dimensions of NORMAC TEES correspond with old malleable iron fittings. This feature is extremely important in the use of these fittings in one foot openings where the tubing must line up with the steel which has been removed.

Write for the NORMAC CATALOG of Gas Distribution Equipment

NORTON-McMURRAY MFG. CO.

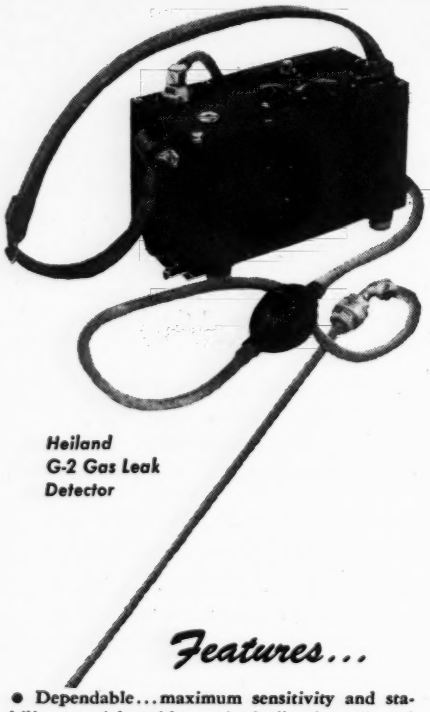
122 SOUTH MICHIGAN AVENUE - - - CHICAGO 3, ILLINOIS

Couplings • Meter Bars • Sleeves • Cocks • Bell Joint Clamps • Service Tees & Ells

Heiland
DENVER

Economical Efficient

Gas Leak Detection



Heiland
G-2 Gas Leak
Detector

Features...

● Dependable... maximum sensitivity and stability. ● Adaptable to both "aspirator" and "open flow" tests. ● Ruggedly constructed for above average abuse by maintenance crews. ● Lightweight... compact... complete. No separate batteries, meters, gas chambers or dilutors. ● Ability to detect low gas concentrations as well as locating larger leaks. ● Economical operation ...uses only standard flashlight batteries for power source. ● Easy access to all parts of instrument; readily inspected and cleaned. ● Sample may be quickly aspirated through instrument. ● No restrictions in sample path; any rate of aspirator pumping satisfactory. ● Double filters retard the introduction of dirt and dust into gas chamber, greatly prolonging life of filaments. ● Three screens for ample explosion check.

For further details write or wire...

HEILAND RESEARCH CORPORATION
130 East Fifth Ave., Denver 9, Colo.

dependable instruments

Heiland
DENVER

Final assembly lines at A. O. Smith Corp.'s Kankakee (Ill.) Works where a replacement program is under way to double domestic water heater manufacturing capacity.

Replacement Program Will Boost A. O. Smith Output

A $600,000 "replacement" program which will boost output of glass-lined (Permaglas) water heaters from 26,000 per month to 50,000, starting in January 1953, has been announced by the water heater division of A. O. Smith Corp. at Kankakee, Ill. Lower costs and higher quality have also been promised under the plan.

Substitution of a competitively priced Permaglas model for galvanized heaters formerly produced, plus operational improvements in the production line, are the principal elements in the program.

Until the perfection of the process for making glass-lined water heaters made it possible to produce popular priced units, Smith's lines turned out galvanized models as well as the higher-priced Permaglas heaters, but the former are now being discontinued.

In production techniques, Smith engineers have perfected four basic improvements which will permit the retention of the four advantages claimed for glass-lined, "corrosion-proof" water heaters while substantially lowering manufacturing costs.

To retain the glass lining at a lower cost, Smith researchers found a glass formula that is 2½ times as corrosion resistant as that used in 1940, and which can be bonded to steel much more readily than the earlier type. Special premium steels are no longer necessary, and these are being replaced with ordinary carbon steel. Visual inspection of the tank interior has also replaced the costlier electrical inspection procedure.

Carbon steel spuds, glass coated, have replaced stainless steel at a saving, eliminating a metal which was dissimilar to the tank steel and thus cutting down corrosion possibilities.

Shielding of the copper on the inside of the tank to prevent circuiting to the steel tank wall is a further protection. A magnesium "neutrolizer" rod double-proofs the tank against corrosion, acting as a standby to protect the inside of the tank where steel might become exposed to the hot water. In this capacity, it is claimed that the neutrolizer will last indefinitely, as it has little work to do.

Improved steel cleaning methods, a new type "mash seam welder" to replace the old flash welding machine, faster testing through the use of mandrils inserted into the tank (with which only enough water needs to be introduced to fill the void between mandrils and tank), and automatic tank fabrication will also materially speed production.

NPA Orders Metal Bonus; Ups 1st Quarter Steel

A "metal bonus" for gas appliance manufacturers and others will be distributed by the National Production Authority for the second quarter of 1952. DPA has made available to NPA about 20 million lb of brass mill products, 5 million lb of copper foundry products, 30 million lb of aluminum, and additional tonnage of carbon sheet steel, strip, and blackplate.

Manufacturers who filed supplementary requests for materials and prove that the materials can be used will be allowed the bonus. Those who have filed and been granted additional materials will not be eligible.

Last month NPA announced that automatic 10% increases in first quarter allotments of carbon steel were going out to a number of civilian-type products. The original list was extended to include all products under the consumer durable goods division which can be made with available types of carbon steel.

Additional amounts to be allotted as first quarter supplies include 2222 tons for domestic heating stoves and space heaters and 4791 tons for domestic cooking stoves.

Combined Code Suggested

Under a recommendation recently adopted by the Domestic Water Tank and Water Heater Industry Advisory committee, meeting with NPA, electric and gas heater codes would be combined so that critical allotted materials might be used for the manufacture of either type heater.

NPA told the committee that sheet and

strip will be in "fairly good supply" during the second quarter and that this situation would probably continue through the third and fourth quarters.

Newsnotes

Representatives who attended the annual sales meeting at the recently completed factory and office building of Eclipse Fuel Engineering Co., Rockford, Ill. on Feb. 28-29 were shown for the first time the company's new Fyr-Matic combination oil and gas burner. Other new products were also shown at the meetings which were held in the new air conditioned auditorium.

Chicago's Edgewater Beach hotel recently was the scene of Hill, Hubbell & Co.'s 16th annual sales meeting. Guest of honor at the three-day confab was H. L. Jones, president of General Paint Corp. of San Francisco, of which Hill, Hubbell is the eastern pipe coating and wrapping division. The company is located in Cleveland, with plants at Lorain and Girard, Ohio, and Hammond, Ind.

Jones & Laughlin Steel Corp. has awarded Koppers Co. Inc., Pittsburgh, a contract to design and build a new battery of chemical-recovery coke ovens at its Hazelwood plant in Pittsburgh. Koppers will also build a new coal bin and coal conveyor system.

By mid-summer, Whirlpool Corp., St. Joseph, Mich., expects to re-enter consumer markets with its home laundry equipment. Material shortages forced the company to withdraw about a year ago. The plan for increased output is based on anticipated availability of raw materials and component parts and reasonable certainty of increased production facilities by mid-year.

Salese and Promotion

Manufacturers Begin "Proof of Profits" Ads

Manufacturers' ads will begin appearing this month to tell the story of the spring Proof of Profits campaign which began last month. Part of a long-term AGA program to sell commercial gas cooking equipment, the drive is also expected to improve the quality of equipment in use, promote an increase in this profitable load, and cement relationships among gas companies, kitchen equipment dealers, and manufacturers.

Individual utility participation will range from a stepped-up advertising campaign to one that will go all-out in giving cash prizes to salesmen, trade-in allowances, finance plans, etc.

The phrase "proof of profits" will be featured in AGA, manufacturer, and gas company advertising in an effort to get restaurant operators to recognize it as synonymous with modern gas cooking equipment and profitable operation.

Houston Natural Begins Biggest Dealer Promotion

"Homemakers' Festival," a two-hour stage food and appliance show, last month began showings in Houston Natural Gas Corp.'s 20-county system. According to Rolland

get a Bantam®!

Why fuss around with special "one-purpose" machines, or costly hand crews, when a *low-cost* BANTAM Back Hoe will handle *all types* of trenching jobs at a big saving in time and labor. Truck-mounted BANTAM drives anywhere, on or off highway, at truck speeds . . . maneuvers in close quarters, steep grades and swampy soils, where bigger machines can't go . . . *digs up to 100' of 5' trench per hr.* Send for complete facts today, including details on BANTAM crane adaptor and fast-change backfill blade (extra) for handling *entire* pipe installation with *same* machine.

SB-H-6

Bantam Hoe digs to 14' depth . . . uses 20", 25" or 30" buckets. Easily converted to dragline, clamshell, crane, shovel, etc. Specially engineered for truck mounting.

MAIL COUPON FOR COMPLETE FACTS!

Schield Bantam Co.
268 Park St. Waverly, Iowa

☐ Send details on BANTAM Hoe, including crane adaptor and backfill blade.

Name_____
Position_____
Company_____
Address_____
City_____ State_____

SB-H-6

Cranes • Excavators
Get more jobs done at less cost

Storey, sales promotion manager, the presentation is the first of three intensive system-wide promotions designed to make gas appliances "easy to sell, profitable to sell, and easy to buy."

The 1952 plan, most ambitious dealer assistance program in the company's 26-year history, officially got under way March 7 when regional appliance and food manufacturers' representatives saw a preview of the Festival. The activity ties in with AGA's $750,000 national advertising campaign and promotions planned by appliance manufacturers.

The Festival, which will travel 1100 miles to play 28 performances in 21 communities, will give attendants hundreds of door prizes, appliance and food products literature, and one range at each showing. Forty thousand invitations have been mailed to homemakers in Houston Natural's territory.

February Shipments Down

GAMA reports that February shipments of gas-fired central heating equipment totaled 32,300 units, 10.8% less than January shipments. During the first two months of 1952, unit shipments totaled 68,500 as compared with 108,200 shipped during the same period last year.

For January and February this year, unit shipments were as follows: furnaces, 22,600 and 20,800; boilers, 2900 and 3500; and conversion burners, 10,700 and 8000.

Capacity Increase!

Added capacity at critical points can solve troublesome control problems — in gas, too!

Model RV-50 MAXITROL Gas Regulators in both ½" and ¾" pipe sizes now have an "extra" in the form of added capacity! Higher ratings were awarded by the AGA in December, 1951. The higher ratings appear for the first time in the January, 1952 issue of the AGA Directory. Old and new capacities are shown below:

		CAPACITY RATING (A.G.A. Listed)		
		Cu. Ft./Hr. at .3 Pressure Drop 0.6 Sp. Gr. Gas	Btu/Hr. Gases 800 Btu/Cu. Ft. or More (Natural Gas)	Btu/Hr. Gases Less Than 800 Btu/Cu. Ft. (Mfd. Gas)
FORMER RATING	RV-50—½"	252	186,500	126,000
	RV-50—¾"	253	187,200	126,500
PRESENT RATING	RV-50—½"	270	200,000	135,000
	RV-50—¾"	270	200,000	135,000

This "extra" capacity can cut your costs by reducing manifold components to ½" from ¾" pipe size . . . insure optimum performance under severe operating conditions.

DETROIT REGULATOR CO.
1742 RIVARD STREET DETROIT 7, MICHIGAN
Sold on the Pacific Coast by: PACIFIC SCIENTIFIC COMPANY
San Francisco, Los Angeles, Seattle, Portland

CURRENT READING

CATHODIC PROTECTION OF STEEL UNDERGROUND — National Bureau of Standards. A recent study by W. J. Schwerdtfeger and O. N. McDorman of the National Bureau of Standards corrosion laboratory provides a better understanding of the mechanism of this important method of inhibiting underground corrosion. The NBS study centered around laboratory determination of the optimum potential to be maintained for effective protection.

By eliminating uncertainties inherent in field measurements, NBS was able to determine an optimum protective potential having a firm scientific basis. The value arrived at—minus 0.77 volt referred to a saturated calomel electrode (—0.85 referred to a copper-copper sulfate electrode)—was confirmed by weight-loss measurements on electrodes maintained at the selected potential in five corrosive soils.

Since this value corresponds approximately to —0.85 volt referred to the copper-copper sulfate electrode, the NBS work confirms the practice of cathodic-protection engineers for the special condition when all IR drop is eliminated except that which is included in the field of the normal corrosion circuits.

For further details of this work, see "Potential and Current Requirements for the Cathodic Protection of Steel in Soils," by W. J. Schwerdtfeger and O. N. McDorman. (Obtainable from Superintendent of Documents, U. S. Government Printing office, Washington 25, D. C., at cost of 15 cents.)

EXPANSION BEHAVIOR OF COAL DURING CARBONIZATION — Institute of Gas Technology Research Bulletin 11 summarizes significant findings and opinions regarding coal carbonization and coal properties. This literature survey is supplemented by first-hand inspection of current coke oven practice in modern plants.

A special analysis has been made of possible correlations between expansion pressures developed during carbonization and the properties of coal which were measured in the laboratory. The conclusion was reached that while none of the correlations hitherto attempted permits coke oven behavior to be predicted from laboratory determinations of coal properties, nevertheless, attainment of this goal is within the possibilities of further intensive research. Price: $5.

THE CORROSION OF METALS AND MATERIALS BY THE PRODUCTS OF COMBUSTION OF GASEOUS FUELS—Published as AGA Research Project DGR-4-CH, a PAR plan activity. Studies of 16 metals and ten coatings indicated that under severe corrosion conditions only a few of the materials would give extended service. These materials were stainless steels, aluminum and alloys, and aluminum-coated steels. Under no or very low sulfur conditions, such as in a natural gas area, essentially all of the materials provided excellent corrosion resistance. Also presented are methods for employing the results to predict corrosion behavior of new appliances where past history is known. Price: $1.

SULFUR POISONING OF NICKEL CATALYSTS—Institute of Gas Technology Research Bulletin No. 10. This publication describes research determining effects of various kinds of organic sulfur and the amounts which industrial units might be expected to tolerate when operated for the production of fuel gas.

A systematic study was made of the relative performance life and activity of a commercial nickel catalyst when steam-gasifying a natural gasoline to which various sulfur compounds were added in controlled concentrations. Conclusions drawn were: (1) The catalyst life and efficiency vary with the kind and amount of sulfur compound present. (2) The performance of nickel catalysts in the presence of sulfur can be improved by appropriate selection of feed rates, steam concentrations, and operating temperatures. (Specifically, the addition of process air lengthens the operating period before regeneration is necessary.) (3) No permanent impairment of the nickel catalyst need be caused by sulfur in any amount or form if proper conditions of catalyst regeneration are observed. Price: $2.50.

METHODS OF MEASURING HUMIDITY AND TESTING HYGROMETERS—by Arnold Wexler and W. G. Brombacher, Natural Bureau of Standards Circular 512. No satisfactory method for the measurement of the relative or absolute humidity of gases exists at present, for some applications, and available information on methods and instruments for measuring humidity is scattered. This circular answers comprehensively questions on humidity measurement. (Obtainable from Government Printing Office, Washington 25, D. C., at a cost of 15 cents.)

PRODUCER GAS — Arrow Press Student Publication No. 4, published by Arrow Press Ltd., 157 Hagden Lane, Watford, Herts, Great Britain. This publication, although written primarily for students, will interest others connected with the gas industry. Bischof of Megdeburg in Germany is credited with having built the first gas producer in 1839. The phases of development following and the design and operation of modern installations are described in detail. The book is illustrated with photographs and colored diagrams.

SAFETY MANUAL FOR PIPE LINE CONSTRUCTION—Issued by Pipe Line Contractors Assn., Dallas. This 44-page manual details safety measures to be taken in a carefully formulated safety and accident prevention program. Insurance rates and direct job costs indicate the necessity of reducing the number and cost of accidents in the pipeline construction industry. This booklet was prepared by a committee from the association with the assistance of insurance company safety engineers.

THE MODERN GAS ENGINE—by Ralph L. Boyer and W. R. Crooks, Cooper-Bessemer Corp., Mount Vernon, Ohio. This paper, presented at the oil and gas power conference of the ASME and now available in bound form, provides data, photographs, and charts on the development of the large internal combustion engines used for pipeline transmission service and electric power generation. Also discussed are the installation and operating economies of different types of design on various services.

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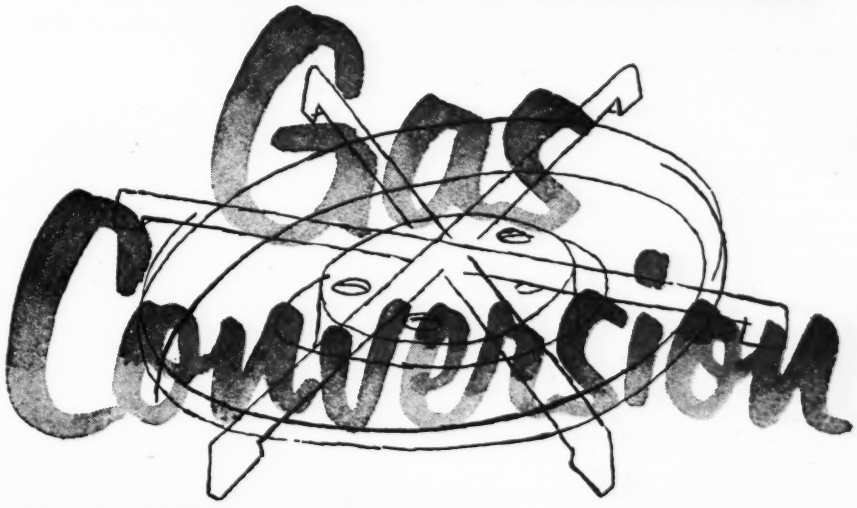

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BIBLIOGRAPHY ON THE MEASUREMENT OF GAS TEMPERATURE — by Paul D. Freeze. National Bureau of Standards Circular 513. Accuracy in measurement and control of such temperatures as those of the working media of gas turbines and jet engines presents many problems. This publication is to facilitate reference to the literature in this field.

It was prepared in connection with a program now under way at the NBS which includes the development of more accurate and more rugged temperature measuring instruments, the perfection of various spectroscopic methods, the extension of the theoretical background, and a study of the real significance of the measured values of such temperatures.

Classified topically in accordance with instrument type, the bibliography provides a list of articles related to gas temperature measurement covering the 20 years prior to January, 1951. (Obtainable from Government Printing Office, Washington 25, D. C., at cost of 15 cents.)

INDUSTRIAL GAS NOMENCLATURE—Information Letter No. 44 prepared by D. A. Campbell of the industrial gas practices committee, AGA. This letter was intended to establish standard names for gas combustion systems, mixers, and burners. Gas engineers in different localities differ in their interpretation of terms applied to gas combustion systems and equipment.

PETROLEUM DICTIONARY AND HANDBOOK—Prepared by Petroleum Educational Institute, 9020 Melrose Ave., Los Angeles 46. This book contains simple, understandable definitions of technical and semi-technical terms in connection with the application and use of petroleum products and equipment utilizing these products. Price: $8.

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PEOPLE

H. L. Wheeler

J. W. Crawley

Hays Manufacturing

Hays Manufacturing Co., Erie, Pa., has appointed HENRY L. WHEELER as sales representative in the New York-New Jersey territory. He succeeds ROBERT HUTCHINGS, who has been promoted to assistant sales manager in charge of the company's industrial sales division. JAMES W. CRAWLEY has taken over the Kansas, Missouri, Oklahoma, and Arkansas sales territory.

New manager of General Controls Co.'s Cleveland branch office is WILLIAM M. ROECKER. He has been associated with the Glendale, Calif. firm since 1947.

R. G. RINCLIFFE has been elected to succeed H. B. BRYANS as president of Philadelphia Electric Co. Mr. Rincliffe joined the utility in 1923 and progressed through various positions, becoming a director and executive vice president in 1950. Mr. Bryans joined Philadelphia Electric in 1929 and became president in 1947. Last month he was elected vice president and a director of United Engineers & Constructors Inc., Philadelphia.

R. G. Rincliffe
Philadelphia

A. H. Knief
Davey

Appointment of A. H. KNIEF as regional manager of Davey Compressor Co., Cleveland, in the Milwaukee territory has been announced. Mr. Knief will cover Wisconsin, upper Michigan, Minnesota, Iowa, Illinois, and Missouri.

H. J. Carson

A leave of absence has been granted to HIRAM J. CARSON, and he has resigned as first vice president and director of Northern Natural Gas Co., Omaha, and as director of Peoples Natural Gas Co., a subsidiary. Mr. Carson will reach his normal retirement date on Dec. 1, 1952, and the leave of absence will be effective until that time. Mr. Carson is well known for his work in the fields of dehydration, hydrogen sulfide removal, and the all-welded large diameter pipeline. Last fall he received the AGA's Distinguished Service Award. He has been an active AGA committeeman and is a past president of the Mid-West Gas Assn.

A series of promotions resulting from expansion of the organization has been announced by Blaw-Knox Co., Pittsburgh. ARTHUR A. LEVISON, division vice president, has been promoted to vice president and general sales manager. H. RUSSELL LOXTERMAN is now assistant general sales manager, Blaw-Knox division, and will also continue as manager of the steel plant equipment department. Also promoted was OTTO G. SCHWENK, who is now vice president in charge of industrial products.

New district superintendents are JOHN W. HUBBARD, HERBERT MORGAN JR., and J. C. TOOKE. The latter two will headquarter in Pittsburgh, Mr. Hubbard in Tulsa.

KENNETH WHYLAND has been appointed coordinator of service operations of Niagara Mohawk Power Corp., Albany, and will be responsible for service practices in the company's three divisions. He entered the service department in 1929 and has been service advisor of the commercial department, Eastern division, for the past ten years. He was also coordinator for the changeover to natural gas in the Eastern division last year.

Other recent appointments at Niagara Mohawk are those of ROBERT W. POWELL and WALTER G. FIELDER to area superintendents for the Watertown and Potsdam operating districts, respectively.

For his success as chief executive of a progressive public utility, his unselfish service to the community, and his interest in and support of the cultural advantages of the greater Cincinnati area, WALTER C. BECKJORD, president of Cincinnati Gas & Electric Co., recently received the honorary degree of doctor of laws from Miami University, Oxford, Ohio. Mr. Beckjord delivered the commencement address at the mid-year exercises.

Additional officers named at United Natural Gas Co.'s (Oil City, Pa.) recent board of directors meeting included FRANK F. THURSTON, assistant secretary, and HOWARD C. ROSE, assistant treasurer. All other officers were re-elected, as were five retiring directors.

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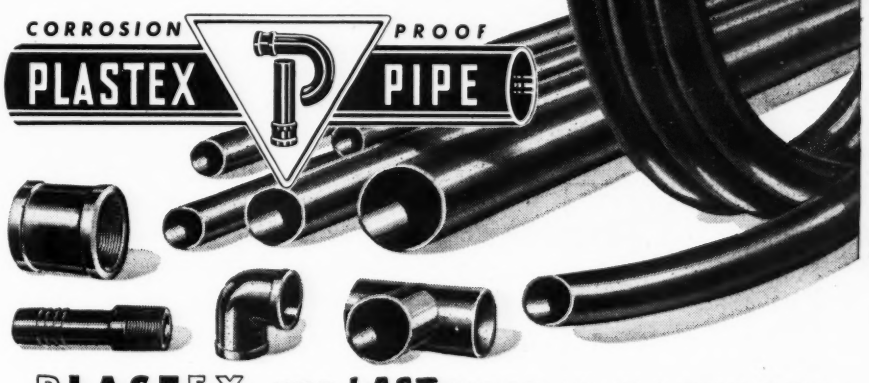

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Honolulu Gas Co. has named ROBERT D. SCOTT, former director of appliance merchandising for the Fred Meyer stores in Portland, Ore., as sales manager. Mr. Scott spent five years with Pacific Gas & Electric Co. in San Francisco, built and operated butane plants in Washington and Oregon, and then served as appliance sales division manager for General Electric in Seattle and Portland.

Piedmont Natural Gas Co. Inc., Spartanburg, S. C., has appointed HENRY JAMES general counsel and elected him a director and member of the executive committee. K. M. BRIM has been appointed associate general counsel.

JAMES E. HUMPHREYS, manager of the Twinfuel division of Norman Products Co., Columbus, has also been placed in charge of advertising and sales promotion for the Norman line of conversion burners, furnaces, and overhead heaters. Mr. Humphreys was business promotion manager of Ohio Fuel Gas Co., Columbus, for 17 years before joining Norman Products in 1951.

HORACE P. LIVERSIDGE, chairman of the board, Philadelphia Electric Co., received the William Penn award of the Chamber of Commerce of Greater Philadelphia at the group's annual dinner and meeting recently. Mr. Liversidge is the first Philadelphian to have received the chamber's national award.

J. C. Reid **H. N. Oldham**
Southern Union Gas Co.

Two Dallas officials of Southern Union Gas Co. have been promoted. JAMES C. REID, vice president, operating manager, and a director, was named to the new position of executive vice president, and H. N. OLDHAM, assistant operating manager, was elected vice president and operating manager. They have been associated with Southern Union for 16 and 17 years, respectively.

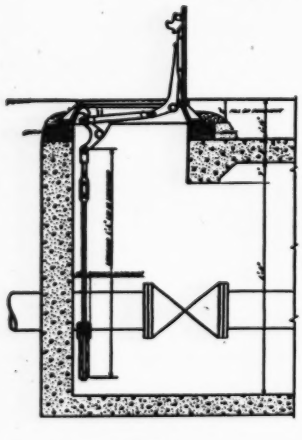
W. J. AMOSS has resigned his position as vice president in charge of advertising for New Orleans Public Service Inc. and has been succeeded by J. MASON GUILLORY. Mr. Guillory, with the company since 1931, served in engineering and sales positions until his appointment in 1940 as manager, industrial and commercial division.

Three promotions announced by the company are: JOHN F. MORTON, supervisor in the industrial division, to manager of that division; JAMES L. CAMPBELL to manager of the commercial division; and CHARLES J. SINNOTT to manager of the residential division, succeeding Mr. Campbell.

Several executive changes have been announced by Amercian Radiator & Standard Sanitary Corp., Pittsburgh. To fill the position held by the late J. P. Cosgrove, JOSEPH A. GRAZIER has been elected executive vice president, a director, and a member of the executive committee. Mr. Grazier was serving as vice president and secretary and has been succeeded as secretary by FRANK J. BERBERICH, assistant secretary. W. WALTON WOODROOF has been added to the engineered products division staff. He will serve as field sales engineer.

Three promotions have been announced by Natural Gas Equipment Inc., Pasadena and San Francisco. A. C. STAAT is now NGE's division manager. HERB DUNCAN is the new manager of the company's commercial department, and JACK CAMERON has been promoted to manager of the industrial department. Cameron, who was associated with the Surface Combustion Corp. in Toledo and Cleveland for 14 years and has been with NGE since 1950, has been transferred from the firm's Pasadena office.

Petersburg (Va.) & Hopewell Gas Co. has elected HALDOR M. KIRBY treasurer of the firm, and CECIL H. GOODRICH has been named accountant and assistant to Mr. Kirby. H. H. HARPER, former secretary and treasurer, is now Petersburg district manager and secretary.



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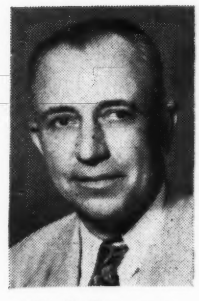


W. E. Ferguson
Ohio Fuel

J. M. Rutherford
Ohio Fuel

N. L. Johnson
Hamilton Mfg.

A number of promotions, headed by the election of JAMES A. SCANLON and WILLIAM E. FERGUSON as vice presidents and JOHN M. RUTHERFORD as treasurer, have been announced by Ohio Fuel Gas Co., Columbus. Mr. Scanlon, former treasurer, is now in charge of rates and regulations, and Mr. Ferguson, manager of the production and storage department, is vice president in charge of that department. Mr. Rutherford continues as secretary. PAUL W. ROGERS, superintendent of motor transport, has been named assistant chief engineer for Ohio Fuel, and THOMAS E. DARBY was advanced from utilization engineer to plant and service operations manager.

T. H. KENDALL has been appointed assistant vice president in charge of operations by Equitable Gas Co., Pittsburgh. A member of the firm since 1924, he began as a fieldman in the distribution department and was successively promoted to district supervisor, district foreman, division superintendent, assistant general superintendent of distribution, and, from 1930 until 1952, general superintendent of distribution.

Two appointments to the engineering staff of Servel Inc., Evansville, Ind., have been announced by the company. THEODORE W. RUNDELL, formerly chief refrigeration engineer for Philco Corp., has been elected vice president in charge of engineering, and DR. WILLIAM R. HAINSWORTH, whose position Mr. Rundell has filled, has been named staff consulting engineer. Dr. Hainsworth will continue as a vice president.

ARTHUR F. DRIES, Gar Wood Industries Inc., has been promoted to the position of sales promotion and advertising manager. He is in charge of the corporation's central advertising department for the Findlay, Wayne, St. Paul, Richmond, and National Lift divisions, as well as the Gar Wood branch offices in major cities throughout the country.

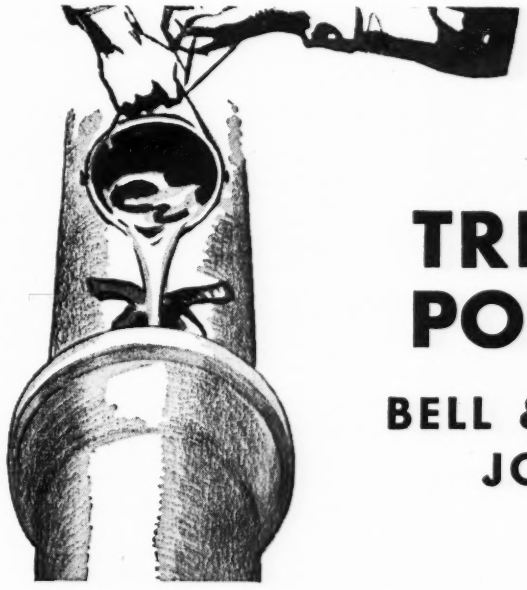
EDWARD R. SHARP, chief of the division of gas and water distribution, Richmond (Va.) Dept. of Public Utilities, has resigned to become field superintendent of construction for an engineering company. Mr. Sharp played an important role in the recent introduction of natural gas to the city.

WILLIAM ANDERSON, Pittsburgh attorney, has joined the legal department of Manufacturers Light & Heat Co. and associated Pittsburgh Group companies in the Columbia Gas System.

After an 18-month leave of absence for Air Corps service, NORMAN L. JOHNSON has rejoined Hamilton Manufacturing Co., Two Rivers, Wis. He has been appointed dryer promotion service manager of the home appliance division.

JOHN C. BOLENDER, who last August joined Peoples Water & Gas Co., North Miami, Fla. as manager of operations, has been promoted to vice president in charge of operation.

Consolidated Edison Co. of New York Inc. has elected JAMES DECAMP WISE, president of Bigelow-Sanford Carpet Co. Inc., a trustee of the company. He replaces Edward P. Prezzano, who retired last year, on the ConEd board.



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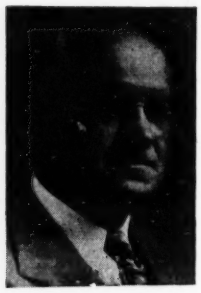


Henry Fink
Mich. Con

Election of HENRY TUTTLE as president of Michigan Consolidated Gas Co., Detroit, has been announced by the board of directors. HENRY FINK, president since 1946, was elected chairman of the board and chief officer of the company, while WILLIAM G. WOOLFOLK, president and chairman since 1932, was chosen chairman of the executive committee. Mr. Tuttle, who has been with the company for 32 years, became executive vice president in May 1949. ELLSWORTH G. REYNOLDS, legal and administrative assistant of MichCon, has been named an assistant secretary of the company.

JAMES F. OATES JR., chairman of Peoples Gas Light & Coke Co., Chicago, was featured recently in the Chicago *Tribune* series, "How Men at the Top Won their Place." A native of Evanston, Ill., Mr. Oates received his bachelor of arts degree from Princeton and a law degree from Northwestern university. He became chairman of Peoples Gas in 1948 after a successful career as an attorney. The weekly feature on business leaders appears every Saturday in the business news section of the newspaper.

WALTER E. LONG has been elected a director of Lebanon (Pa.) Valley Gas Co. and FRED B. HOFFT has been named president, both succeeding the late William Naile. Mr. Hofft has been succeeded as vice president by M. H. PARKINSON. All three men are vice presidents of United Gas Improvement Co., Philadelphia, Lebanon Valley's parent. The new position of general manager of Lebanon has been filled by RUSSELL W. UHLER, an employee of the company since 1921.

DICK BERNARD, Ralston manager of Peoples Natural Gas Co., Omaha, for the past ten years, has been promoted to assistant in the Omaha office to Ray Harrison, vice president and general manager. He has been succeeded by ART BROWNLEE, assistant manager at Ralston since August, 1950. Mr. Bernard joined the organization in 1931, Mr. Brownlee in 1942.

Weathercasts of America, St. Louis meteorological consulting firm specializing in forecasts and weather surveys for the public utility industry, has named ARMAND R. IACCHEO as operations manager. Mr. Iaccheo was a special service forecaster for the U. S. Weather Bureau in St. Louis.

THOMAS L. BLOSE has joined A. O. Smith Corp. of Texas as chief engineer at the company's Houston pipe mill. He was formerly at the Spang-Chalfant seamless tube mill at Ambridge, Pa.

J. K. Horton
Pac. Pub.

D. K. Kramer
Amer. Meter

J. K. HORTON has been elected president of Pacific Public Service Co., San Francisco, succeeding ERNEST G. LAWSON, whose retirement became effective March 1. Mr. Horton was also elected chairman of the board of Coast Counties Gas & Electric Co., Santa Cruz, Calif. subsidiary of Pacific Public Service. Since joining the latter company in 1944, Mr. Horton served as corporate secretary and legal counsel. Last year he was elected executive vice president of the corporation and its subsidiary. Mr. Lawson, who has been associated with the gas and oil industries for more than 40 years, served as president of the Pacific Coast Gas Assn. in 1951, vice president in 1950, and as a director in 1948-49 and again in 1952.

American Meter Co., New York, has appointed DOUGLAS R. KRAMER as advertising manager. Mr. Kramer has been with the company since 1944, engaging in research and development work and in the publication of technical literature. He is an instructor in the measurement short courses held annually at the University of Oklahoma and West Virginia University.

Panhandle Eastern Pipe Line Co., Kansas City, Mo., has appointed J. A. FOWLER, former field supervisor, as superintendent of communications. The communications department, which has been under the supervision of F. J. MCELHATTON, superintendent of compressor stations, will now function as a separate unit. JOHN MCCART has been transferred to Kansas City as operations supervisor. He will assist D. K. Stephens, superintendent of pipelines, and J. C. Wright, Mr. Stephens' assistant.

L. E. THOMPSON has been appointed manager of marketing for General Electric Co.'s air conditioning division, Bloomfield, N. J. He was formerly manager of distribution sales. Mr. Thompson has been associated with the company since 1935.

HARRY J. WINES has joined Bryant Heater Division, Affiliated Gas Equipment Inc., Cleveland, as sales promotion manager. He formerly managed distribution sales for General Electric.

A new industrial sales engineer, EDWARD M. DAVIS, has been added to the sales staff of Taylor Instrument Co. in the Tulsa territory. Mr. Davis joined the firm in 1951...

Promotion of CHARLES STANG JR. to chief engineer at Detroit Regulator Co. was announced recently. Mr. Stang, who also serves on the AGA subcommittee listing requirements for domestic gas appliance regulators, joined the firm in February 1951...

PETER V. MARTIN has been appointed a

vice president in the engineering and construction division of Koppers Co. Inc., Pittsburgh, and has left for Santiago, Chile, to become Koppers' representative on the board of directors of Pacific Steel Co. of Chile.

Obituaries

F. D. Howell

On March 6, FRANK D. HOWELL, North Dominion division superintendent of Dominion Natural Gas Co. Ltd., Buffalo, N. Y., died in Brantford, Ont. He joined Cities Service Co., Dominion's parent company, as a junior engineer working out of the Buffalo office, moving to Brantford in 1927. In addition to being an active civic leader, Mr. Howell was a past president of the Canadian Gas Assn. and a member of the Natural Gas & Petroleum Assn. of Canada and the AGA technical section.

LOUIS E. FISCHER, 75, chairman of the board of Kansas-Nebraska Natural Gas Co. Inc., Phillipsburg, Kan., died Feb. 15 in Chicago. Mr. Fischer established the Kansas Pipe Line & Gas Co. at Phillipsburg in 1936 and, in 1941, the firm merged with Nebraska Natural Gas Co. Earlier he helped to organize Northern Natural Gas Co. at Omaha and became president of that company. He pioneered the use of natural gas for pump irrigation, built one of the first alfalfa dehydrating plants in Nebraska, and established the policy of supplying gas to farms along pipelines.

ADOLPH L. WEIL, 76, former president of General Petroleum Corp., died Feb. 25 in Los Angeles. In 1910 he handled the incorporation of General Petroleum's predecessor company, and he served as general counsel for both organizations until his retirement in 1940. He became GP president in 1934. Mr. Weil was an organizer for the Kettleman North Dome Assn., the first important oil field unitization effort.

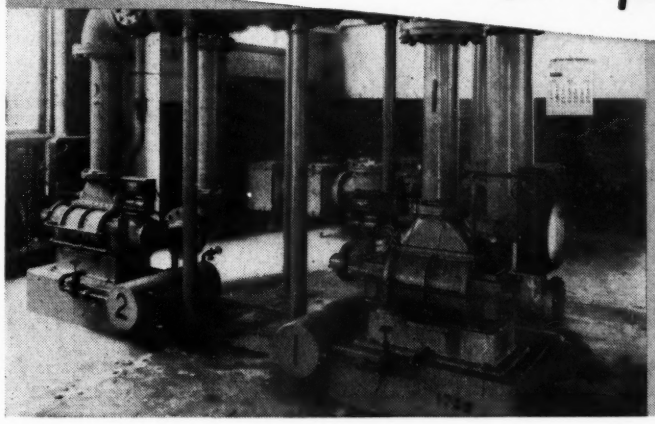
CHARLES A. CONARD, a Philadelphia Gas Works Co. executive until his retirement in 1946, died in St. Petersburg, Fla. on Feb. 14. During his 48 years with the company, Mr. Conard served in many capacities, including manager of the meter reading and credit and collection divisions. He was active in the Pennsylvania and American gas associations.

MORRIS W. KELLOGG, 79, founder and chairman of the board of the M. W. Kellogg Co., died in New York on Feb. 22. In 1901 Mr. Kellogg started his company as a small pipe fabricating shop in Jersey City. He retired as president in 1946 and became chairman of the board.

On March 2, WALTON FORSTALL, retired vice president of Philadelphia Gas Works Co. and former vice president of Franklin Institute in Philadelphia, died in Pittsburgh. He was 82.

MEASURE THESE VALUES WHEN YOU BUY METERS

Accuracy·Capacity·Compactness



Part of an installation of nine R-C Positive Displacement Meters in large chemical plant. Capacities from 3,000 cfh to 130,000 cfh.

Industrial buyers rate R-C Positive Displacement Meters "tops" in these basic essentials.

Accuracy—Not affected by pressure, wide variations in loads or other variables. Simple design, with no vanes, valves or small parts, results in maintained accuracy over long years of operation.

Capacity—from 4,000 cfh to 1,000,000 cfh in one unit, to meet practically any industrial metering requirements. Ample ability to absorb overloads.

Compactness—foot for foot of capacity, R-C Meters are the smallest made for industrial use. Can be "tucked away" in relatively small space without loss of valuable production area.

These values have long been proved by large and small industrial plants and public utilities. More R-C Meters are used by gas producing plants, for their own manufacturing and for commercial customers, than any other make. For details on sizes and construction, ask for Bulletin 40-B-14.

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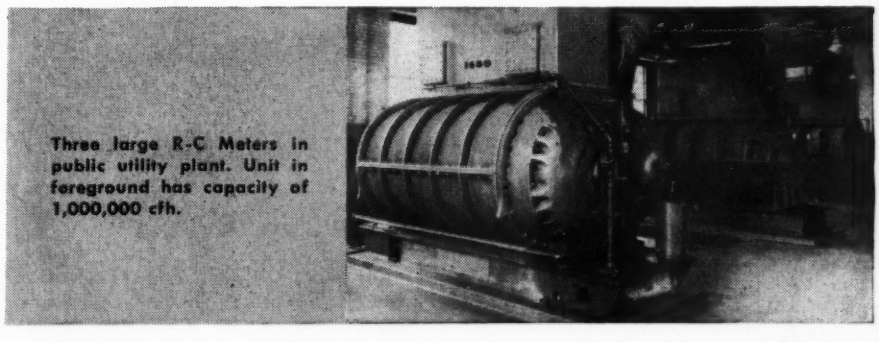

Three large R-C Meters in public utility plant. Unit in foreground has capacity of 1,000,000 cfh.

ROOTS-CONNERSVILLE

BLOWER BUILDERS R-C SINCE 1854

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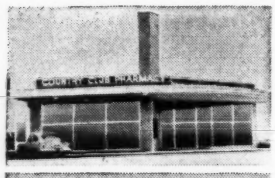
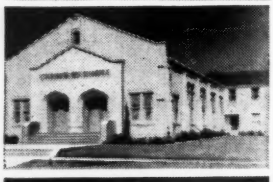
THEY SAY:
"There's nothing like this Air Conditioning"

The "Frida" is Ready-Power equipped

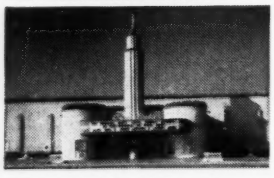


One of many modern pharmacies that depend on Ready-Power.

More and more super markets are using Ready-Power.



Ready-Power is ideal for church air conditioning.



The Casa Linda theatre saves many dollars with Ready-Power.

Ready-Power air conditioning equipment is planned and designed to meet the most exacting requirements with the lowest possible operating costs.

Ready-Power design permits *continuous* operation at varying speeds, which is far superior to "on and off" types. This means that the air conditioning system performs at reduced capacity allowing for a constant dehumidification of the fresh air supply.

The dependable and economical performance of Ready-Power has been proved in hundreds of installations. Names of users will be furnished on request.

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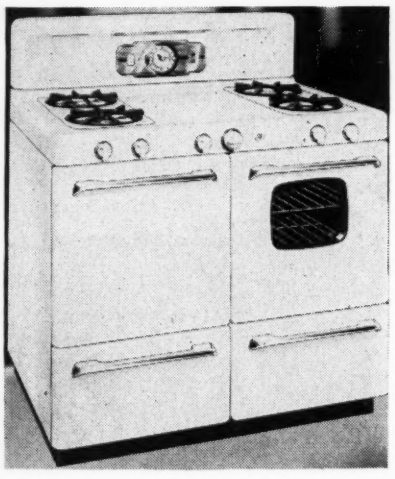
NEW PRODUCTS

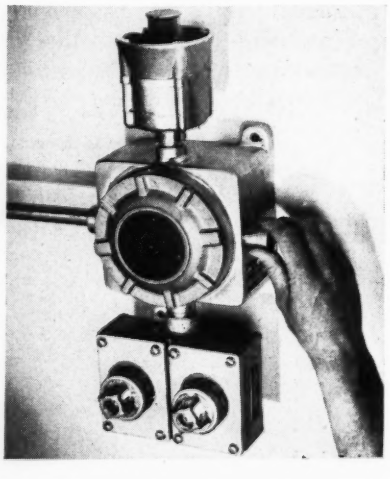


Domestic Ranges

In keeping with the slogan, "A size for every kitchen at a price for every purse," 25 gas ranges have been announced in the 1952 Enterprise line. CP models are available in the 30-, 36-, and 38-in. sizes for the first time.

Features of the various models include streamlined door handles, extra-deep smokeless broilers, larger-than-average one-piece ovens with removable oven bottom to facilitate cleaning, and rustproof alloy burner heads. Some models have clear-view glass oven doors, built-in cook top lighting, choice of high or low broilers, chrome trim on backgrounds, and oven time clocks.

Models: 1952 Enterprise line.
Phillips & Buttorff Manufacturing Co., Nashville, Tenn.



Combustible Gas Alarm

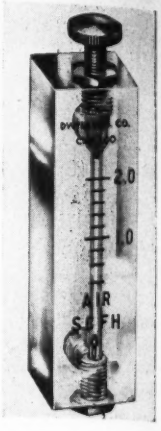
Direct installation in the suspected atmosphere is possible with a combustible gas alarm now being manufactured.

A-c operated, weather-proof and explosion-proof, the model is designed for rough service locations. It utilizes an electronic trigger-tube circuit to convert the sensing-unit signals into alarm indications and may have either self-reset or lock-in arrangements.

The electronic chassis is removable and can conveniently be shop serviced. The single-knob control combines a turn-to-balance and a press-to-test function. Stand-by power from the 115 volt line is 15 watts. The standard alarm point is 0.2 of the lower explosive limit but other values can be provided if required. The sensing unit can be located at a distance from the alarm.

Model: EE Combustible Gas Alarm.
Johnson-Williams Ltd., 2673 Third St., Palo Alto, Calif.

Flowmeters

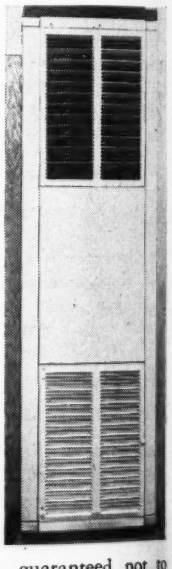


Recently introduced is a new line of precision flowmeters designed to eliminate inaccurate bubble counting and watch timing. Of solid acrylic construction, these flowmeters are precision drilled, reamed, and polished to form a sturdy, accurate, easily read instrument.

A control valve is built into the standard unit. Single units or one-piece multiple units for 0-2 chf to 1-10 chf at standard conditions are made for front-of-board or flush mounting. Special scale ranges are available when the flowmeters are ordered in productive quantities.

Model: Flowmeter.
F. W. Dwyer Manufacturing Co., 317 S. Western Ave., Chicago 12.

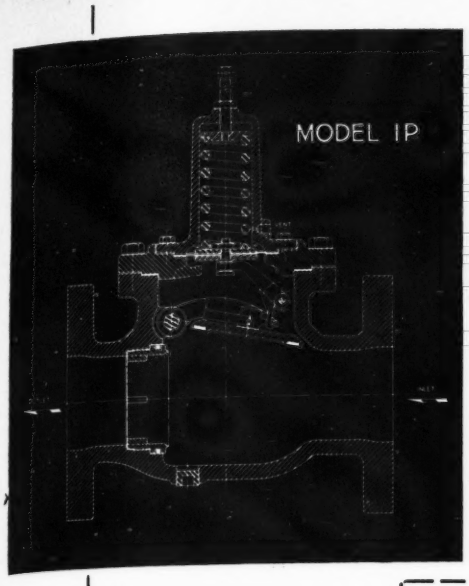
Wall Heater



This AGA-approved, 25,000-Btu input wall heater is particularly adapted for heating small, low-cost houses, extra rooms, garages, utility rooms, and basements. Especially designed for use with concrete slab construction, the heater is useful for modernizing old homes because of its simplified installation requirements, the manufacturer states.

Inside and outside of the combustion chamber are coated with a special ceramic porcelain, guaranteed not to crack or chip. Flow of warm air is directed by special louvers. Furnished with 100% safety pilot or with standard blue flame pilot, the unit is 57½ in. high. Models are available for use with natural or L. P. gas.

John Zink Co., Tulsa, Okla.



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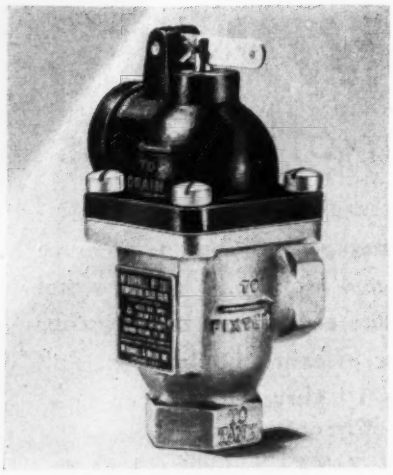

Temperature Relief Valve

Now on the market is a temperature relief valve designed to prevent excessive water temperatures in hot water tanks and heaters and successfully tested by AGA for heat input up to 1,200,000 Btu per hr.

The operating heart of the valve is the Vernatherm thermostatic element which is hermetically sealed and contains a chemical mixture of organic and metallic particles that expand and contract in response to variations in temperature. The valve starts to open at 188° F and reaches maximum capacity at 208° F. It is the automatic reseating type and excessive temperature will not damage the element or cause any variation in calibration. Changes in barometric pressure will not affect its operation.

A fixture connection added to the valve directs the flow of water around the Vernatherm element when water is drawn. This assures more rapid and uniform transmission of temperature variations.

All parts of the valve in contact with water are of nonferrous material. It is suitable for operating pressures up to 125 lbs and the shipping weight is 3 lbs.

Model: McDonnell No. 201.
McDonnell & Miller Inc., 3500 N. Spaulding Ave., Chicago 18.

Air Filter

A clean, white replaceable filter for use in forced air heating and cooling systems, said to offer several design and construction advantages, has been introduced. An outstanding feature is "progressive pack." The glass filaments are packed evenly across the air inlet side and then packed progressively tighter to the air exit side, thereby forming a continuous web that traps dirt on the inside rather than on the face of the filter.

Made of continuous, slightly curled, interlaced glass filaments held in place with a thermoplastic bond and sprayed with a special adhesive, the filter is held in a fiberboard casing between metal grilles.

Standard sizes come packaged 12 to a carton; special sizes may be obtained.

Model: Replaceable filter.
American Radiator & Standard Sanitary Corp., Pittsburgh 30.

Domestic Range

A new gas range with a "Wheel-about" disappearing kitchen table has been introduced by Cribben & Sexton Co. to mark the firm's 80th birthday. The removable cart serves as a storage area with cabinets and a sectional drawer, provides a top quality maple cutting board, is useful as a general service area, and saves steps between work centers, particularly in a large kitchen.

The range in which Wheel-about has been incorporated — the Marlboro — features Simmer-Save and Keep-Warm burners, an oven that the manufacturer claims does not vary more than 2°, and radiant broiling.

Model: Marlboro Range with Wheel-about.
Cribben & Sexton Co., 700 N. Sacramento Blvd., Chicago 12.

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Peerless HEATING EQUIPMENT
THE COMPLETE LINE FOR ALL Gas NEEDS
Forced Air and Gravity Circulators, Radiant Heaters, Panel Heaters and Fan Type Unit Heaters. 68 Years of progressive advancement has developed this complete, tried and proved line—styles, types and sizes for domestic, commercial or defense heating requirements.
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PEERLESS MANUFACTURING CORP., —— LOUISVILLE 10, KENTUCKY

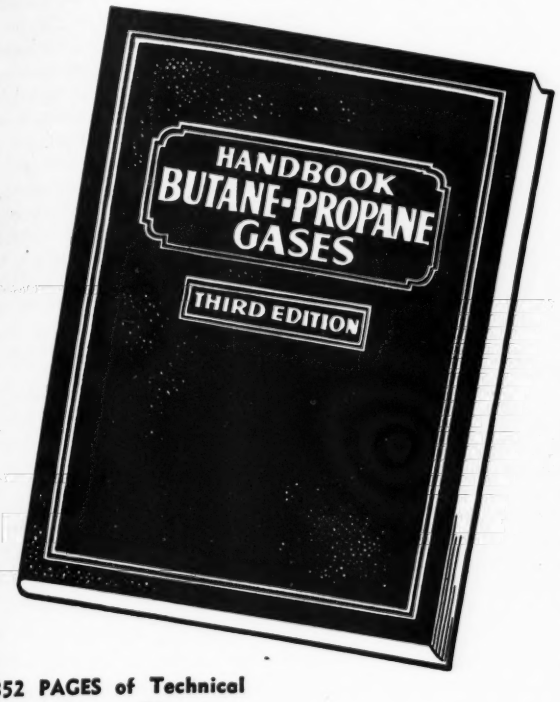
Emergency Light

When regular power fails, this light, which plugs into any 110-volt a-c outlet (d-c available), will operate automatically. It can be clamped to a standard 6- or 7½-volt dry battery, and the 21-c.p. floodlight will give many hours of emergency illumination.

The self-contained, portable unit is adjustable in any direction.

Model: GS No. 16.
General Scientific Equipment Co., 2700 W. Huntingdon St., Philadelphia 32.

The Only Complete Reference Book on Liquefied Gas Engineering, Installation and Operation



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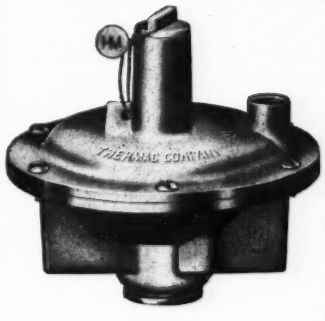

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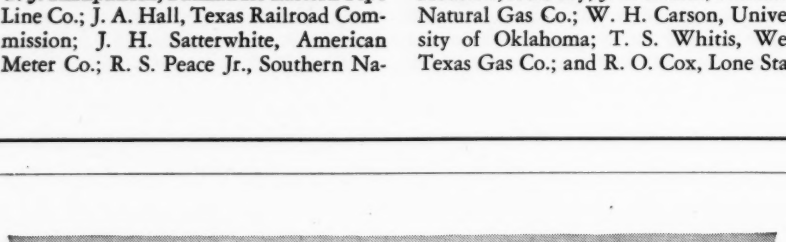
Committee Plans Measurement Short Course

The general committee of the Southwestern Gas Measurement short course at a recent meeting in Houston made plans for the 1952 course, to be held May 27-29 at the University of Oklahoma at Norman, adopted the tentative program, and heard reports of committee chairmen. Attendance is expected to surpass last year's record 942.

Committee members shown in the photograph are, standing, left to right: T. J. Kirkpatrick, Panhandle Eastern Pipe Line Co.; J. A. Hall, Texas Railroad Commission; J. H. Satterwhite, American Meter Co.; R. S. Peace Jr., Southern Natural Gas Co.; George Cragin, El Paso Natural Gas Co.; M. D. Gilbert, Rockwell Manufacturing Co.; E. L. Stark, Foxboro Co.; R. F. Nowlin, United Gas Corp.; J. M. Ribble, Phillips Petroleum Co.; K. R. Tibbets, Warren Petroleum Co.; and Pat H. Miller, Texas Eastern Transmission Corp.

Seated, left to right, are W. A. Griffin, Daniels Orifice Fitting Co.; G. B. Gudger, Gulf Oil Corp.; Mrs. Jeanne Burkey, Houston, secretary; J. L. Griffin, Northern Natural Gas Co.; W. H. Carson, University of Oklahoma; T. S. Whitis, West Texas Gas Co.; and R. O. Cox, Lone Star.



It takes patience, precision, and the highest degree of human skill to change, with a few light taps, a relatively worthless stone to a priceless gem. In the diamond cutting industry, fortunes rest on the *human equation.*

On the human equation, too, rests the efficiency of your cathodic protection system. Efficient corrosion control not only requires the use of the best equipment available, but depends on an exacting analysis of *your* problem, and design, installation and testing by top-notch specialists in the field.

Hundreds of operating installations attest to the dependability and skill of the ERP engineer. Highly trained, and backed by years of experience, he can help you solve *your* pipe corrosion problems too. E-20,

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TRADE LITERATURE

BRISTOL CO., Waterbury 20, Conn. — A new 40-page bulletin, No. F1605, describes the company's "Series 500" line of flow meters in a full range of models, both mechanical and electrical, for uses in industrial plants, utility companies, and process control work. The publication contains information regarding meter bodies, operating principles, primary devices for flow measurement, recording charts, and accessories, and describes instruments for recording, integrating, indicating, automatic controlling, and telemetering the flow of steam, water, air, gas, oil, solutions, and other fluids. The book is illustrated with photographs, reproductions of recording charts, and sketches of methods of applying the instruments.

DRESSER MANUFACTURING DIVISION, Bradford, Pa.—A new four-color laminated wall chart showing the right product for every piping need is available in

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for Pipe of Every Kind and Size
THE QUICK, EASY WAY TO JOIN PIPE
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NO PIPE THREADING FAST SIMPLE
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two sizes—22 x 34 in. with tinned top and bottom for hanging, or 10½ x 16 in. Called the Dresser Handy Product Selector, it will answer questions concerning couplings, clamps, fittings, and repair devices for pipe of every kind and size.

H. D. CONKEY CO., Dept. 188, Field Control Division, Mendota, Ill.—The results of extensive research into the regulation of draft on gas-fired boilers having burners with inputs of 400,000 Btu per hour and over have been published in a new bulletin. It also presents graphs covering various phases of the research and recommendations for correcting the operating troubles encountered.

C. M. KEMP MFG. CO., 405 East Oliver St., Baltimore 2, Md.—"Kemp Combustion Equipment" is the title of Bulletin B-11 presenting the company's complete standard burner listing; seven different types of burners, lighters, and lighter tips, soldering irons, hand torches, fire pots, peep hole covers, observation ports, index cocks, stop cocks, and fire checks.

MINNEAPOLIS-HONEYWELL REGULATOR CO., Brown Instruments Div., Station 40, Wayne & Windrim Aves., Philadelphia 44—Bulletins released recently include the following: Data Sheet 10.15-3a, "Indicating and Recording Flue Gas Analyzer, An Accurate Guide to Efficient and Economical Combustion"; Catalog 9300, "Radiamatic Pyrometers Compensated Radiation Detectors"; Specification Sheet 609, "Electr-O-Vane Control Thermometers"; Bulletin 16-1, "New Non-Indicating Pressure Controller"; Data Sheet No. 10.15-9, "Precise Oxygen Determination Facilitated Through Instrumentation"; Specification Sheet 114, "Pyr-O-Vane Controller"; and Data Sheet No. 7.2-5, "Gas Pressure in Consumer Area Held Constant by New Gas Distribution System."

BUCYRUS-ERIE CO., South Milwaukee, Wis.—"Busy As a Bee" is a two-color, 24-page booklet describing this firm's all-hydraulic Hydrocrane. More than 100 photographs showing the machine doing everything from digging ditches to moving furniture through second-story windows illustrate its versatility. Labeled Bulletin No. H-Uses-1, the publication's contents include placing tanks, pipe, etc.; cleanup work; digging, trenching, and backfilling; hoisting and erecting; loading and unloading; stockpiling and materials handling; and attachments.

CLARK BROS. CO. INC., Olean, N. Y.—A recently published bulletin entitled "The New Clark MA Midget Angle" presents a detailed description of a semi-portable, self-contained compressor station. Designed for rugged service, the semi-portable compressor can be readily transported from field to field.

BLACK, SIVALLS & BRYSON INC., 7500 East 12th St., Kansas City 3, Mo.—Written in non-technical language for easy reading, three new bulletins have been published recently. They are entitled "BS&B Stabilizers," "BS&B Glycol Injection System," and "BS&B Combination Pressure-Vacuum Vent Valves."

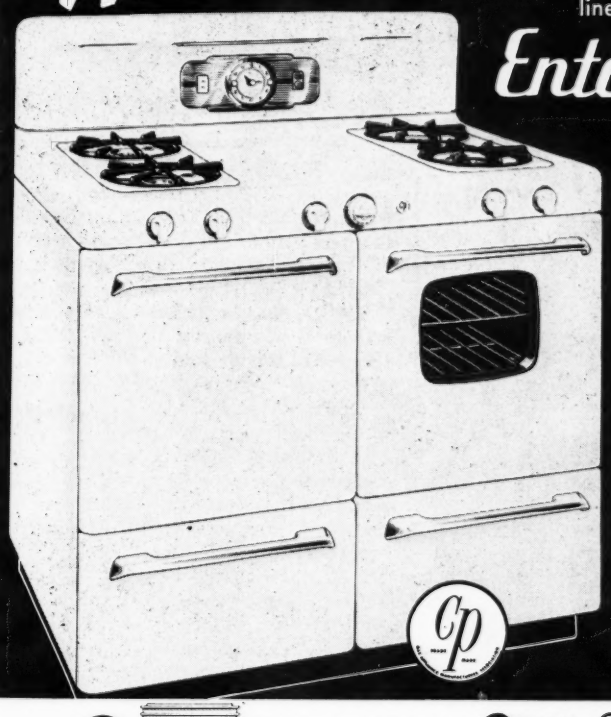
F. W. DWYER MANUFACTURING CO., 317 S. Western Ave., Chicago 12—Precision instruments are pictured in a catalog highlighting the company's new products: slack tube manometers, magnehelic gages, Visi-Float air filter gages, hook gages, and smoke gages engineered for sensitivity and accuracy.

CATERPILLAR TRACTOR CO., Peoria 8, Ill.—Conversion of the Caterpillar D1 300 diesel engine to a heavy duty, spark ignition, natural gas engine is the subject of a four-page bulletin, Form 30283. Low operating cost and versatility of the converted engine are discussed.

SELAS CORP. OF AMERICA, Philadelphia 34—"Fluid Processing" is the subject of a recent publication. Heating liquids, in batches and continuously; liquid phase separation; clarification, polishing and cold sterilization are described briefly.

AUTOMATIC DEVICES CO. INC., Western Springs, Ill.—An indoor-outdoor temperature control, the Weather-Flo, is described in a new four-page bulletin. The control discussed anticipates weather changes and adjusts heat input accordingly.

NEW for '52 Biggest GAS RANGE line ever offered by Enterprise



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ASSOCIATIONS

Emphasis on Safety at AGA Distribution Meeting

Safety in gas distribution operations, a subject that was given a strong boost a year ago at the AGA distribution conference in Memphis, has been accorded top billing in this year's combined distribution, corrosion, and motor vehicles meeting, convening April 7-10 in Philadelphia.

Rather than being set up as a separate activity as was the case in 1951, safety as a theme will run all through the four-day program.

"High Pressure Service Installations and Relief Devices," a paper by Fred H. Bunnell of Consumers Power Co., Jackson, Mich., will share the spotlight with a panel discussion on "Fundamentals of Employee Safety Programs" at the opening general session. "Pressure Control Devices," a study by R. E. Du Vall, Peoples Natural, Pittsburgh, and "The Hidden Hazards of Underground Construction" are billed for the Monday construction and maintenance conference. A talk on "Accident Forms" by E. W. Jahn is scheduled for the opening motor vehicles luncheon conference. Charles E. Bennett, Manufacturers, Pittsburgh, will report on "Public Safety Activities of the AGA" at the second general session. E. W. Jahn of Baltimore will show a "Safety in the Maintenance Shop" film at the Wednesday motor vehicles luncheon.

In its other aspects, the agenda for the four days includes a wide variety of topics. General session papers will include, as well as safety, such subjects as "Designs for Corrosion," "Developments in Mechanical Equipment for Underground Work," "Inspection of Pipe Welds," "Metering Economics," "Cleaning of Leather Diaphragms," "Experiences with Plastic Tubing for Gas Service Piping," "Design of Gas Piping on Bridge Installations," and "Chimney Liners."

Luncheon conferences again will be bidding for attention. On Monday there will be three, on Tuesday four, on Wednesday four, on Thursday two. Two will be held on construction and maintenance (Monday and Friday) under leadership of F. H. Bunnell. The meters and metering group will also convene Monday and Wednesday under direction of Gilbert Estill, Tulsa. Corrosion engineers will gather Tuesday and Wednesday, with A. D. Simpson Jr., United Gas Corp., Houston, presiding, and a discussion of coordination of cathodic protection efforts will be featured. Under G. B. Johnson of Minneapolis and J. C. White of Chicago, customer service men will discuss training and safety topics, winding up their second meeting with a visit to The Philadelphia Gas Works Co.

Distribution design and development conferences will be held Tuesday and Thursday under direction of Karl E. Schmidt, Detroit, with distribution system calculating devices and the subject of dust in systems receiving the lion's share of attention.

Transportation experts will gather for three such conferences, on Monday, Tuesday, and Wednesday, winding up activities with a visit to a petroleum refinery's automotive and research laboratories Thursday afternoon.

AGA Annual Meeting to Consider Seven Top Topics

The seven most seriously considered subjects in the minds of gasmen today, as picked by a representative group of them, have been programmed for the 34th annual convention

Meeting at AGA headquarters in New York recently to plan the display for the national restaurant show May 5-9 at Chicago's Navy Pier were these manufacturers and utility men. From left, seated, Lewis Barry, New York display builder; J. T. Heilig, Savory Equipment Inc.; C. A. Shear, Vulcan-Hart Manufacturing Co.; J. L. Gabris, Robertshaw-Fulton; J. C. Dorsey, East Ohio Gas Co.; M. A. Combs, AGA; R. L. McVicar, Groen Manufacturing; E. J. Horton, Robertshaw-Fulton; Richard Mantz, Magic Chef. Standing, A. S. Hess, Detroit-Michigan Stove; T. M. Offutt, Washington Gas Light; H. S. Walter, AGA; P. C. Grimes, G. S. Blodgett Co.; F. J. Drohan, Cleveland Range Co.

of AGA, set for Atlantic City, N. J., Oct. 27-30.

Meeting at the Biltmore hotel in New York recently, the general convention committee selected these seven: earnings needs of the industry, new plans and decisions of regulatory agencies, servicing responsibilities of gas companies, strong and weak points of the industry, the dealer merchandising plan proposed by the general promotional planning committee, public relations in the gas industry, and the petroleum industry and its future.

Since the meeting will be held in conjunction with the million-dollar GAMA exhibition of appliances and equipment, general sessions will be on a strict time budget to allow delegates plenty of time to view the show. Fewer addresses will be given than in some past years, with intensified coverage of the several most vital subjects of the day. The meeting timetable is also being arranged to permit delegates to see a part of the exhibit each day rather than the entire show in a single day, as before.

Three general sessions are planned—Monday afternoon, Tuesday morning, and Thursday morning—together with a joint session of the Manufactured and Natural Gas Departments.

With nearly 2000 advance registrations already in, staffmen are expecting another record turnout.

Sales Problems Spotlighted At SGA Galveston Meeting

Emphasis will be on the importance of doing a real selling job when some 1600 delegates gather at Galveston, April 28-30, for the 44th annual Southern Gas Assn. convention. In keeping with this theme, a single meeting will replace the usual separate sessions of the commercial sales, home service, advertising, and residential sales groups. Industrial salespeople will hold their own meeting, however.

According to General Convention Chairman Dale E. Frieden, Zenith Gas System Inc., Alva, Okla., meetings will be held at the Buccaneer and Galvez hotels and on the Municipal Pier.

The enlarged sales sessions will be presided over by J. O. Jackson, United Gas, and J. W. Lea, Atlanta Gas Light. "Meeting the Next Crisis" is the topic chosen by A. B. Banowsky, Carroll Distributing Co., Houston, and AGA's Hayes S. Walter will discuss "Opportunity Unlimited." An evaluation of the importance of gas appliance dealers is scheduled, and T. E. Hawkins, Rio Grande Valley Gas, Brownsville, Texas, and John Weymouth, Caloric Stove Corp., Houston, will discuss factory vs. utility responsibility.

At a home service meeting, presided over by Mrs. Arvilla Patison of Lone Star, Fort Worth, Lucy Slagle of Atlanta Gas Light will present a demonstration titled "Sold in Ninety Seconds." Other features planned are "A Year on Television" by Mrs. Elyse Van Dyke, Alabama Gas, Birmingham; and "Proof Positive," a demonstration by Julia Hunter and Harriet Pruitt, Lone Star.

Other sales session speakers include L. J. Fretwell, Oklahoma Natural, "Making the Most of the SMU Test"; Irving K. Peck, Columbia Gas, "There's Much to Do in '52"; Cecil Dunn, Estate Stove, "CP vs. AC"; and Carl H. Horne, Rheem, "Of Interest to the Gas Industry."

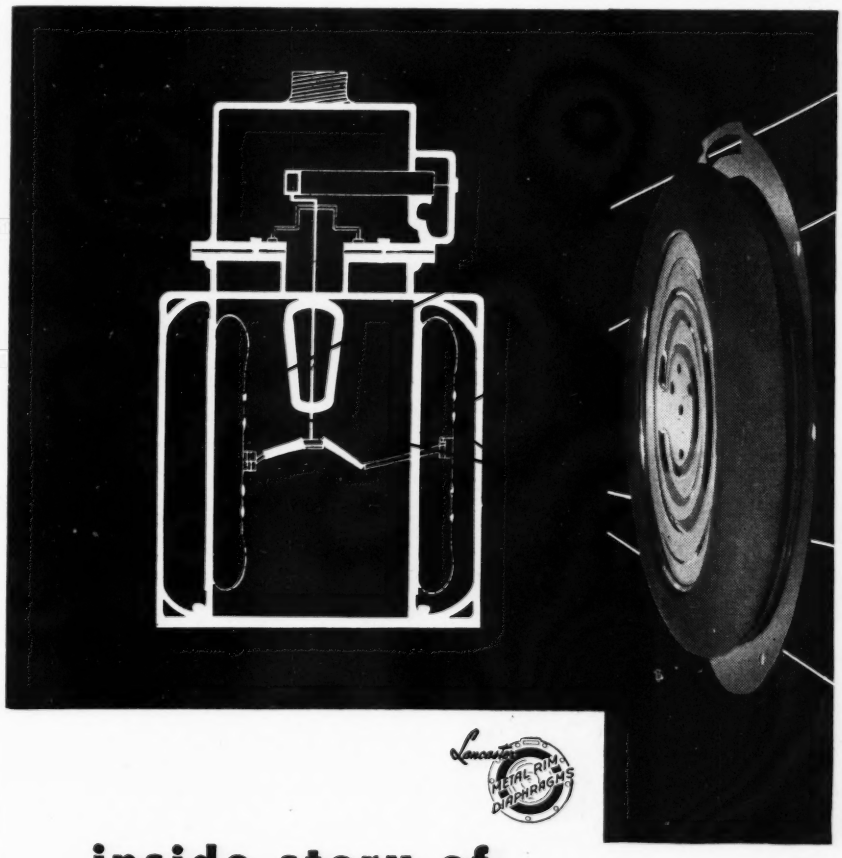
D. A. Frieden
Chairman

L. L. Dyer
SGA Prexy

L. L. Dyer, SGA president, will address the first general session and Managing Director Robert Suttle will make his annual report. "The Path of Progress" is to be discussed by George F. Mitchell, AGA president, and Gerry Swinehart, Carl Byoir & Associates, will talk about public relations.

Sales will come in for attention at a general session, too, when Chester L. May, Lone Star, speaks on "Modern Management Merchandizes." An important speaker from outside the industry will be Ernest O. Thompson of the Railroad Commission of Texas. At a joint distribution-transmission-employee relations luncheon he will point up dangers of federal encroachment in the affairs of state regulatory bodies.

P. A. Leach, United Gas, will address the accounting section on "Semi-Centralized



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Billing and Accounting Plan," and a new program for cutting accounting costs will be described by F. C. Lawrence of Arthur Andersen & Co., Houston. The distribution section will hear results of research on natural gas odorants from Dr. Frank H. Dotterweich, Texas College of Arts & Industries, and Herbert Luoma, Alabama Gas, will moderate a panel discussion on gas codes. In addition, Charles B. Gamble, Birmingham consulting engineer, and R. F. Foster, Lone Star, will be heard by the distribution group.

Stanford H. Downey, Southern Natural, will preside over the accident prevention forum, and J. Mason Guillory, New Orleans Public Service Inc., will head the industrial sales forum.

Transcontinental Gas Pipe Line Corp.'s president, Claude A. Williams, will tell the transmission section about the need for rate increases. Other topics on the section's program include "Chemicals from Natural Gas" and "Security Investments in Natural Gas Transmission." A. L. Roberts, Texas Gas Transmission, will preside.

Commercial and Industrial Conferences in Spotlight

"Gas for Guns and Butter," theme of their forthcoming section conference, is a fitting summation of current activities of commercial and industrial gasmen this month and next.

Already deeply involved in putting across their spring "Proof of Profits" campaign, men of utilities' commercial sales departments will meet with the "guns" segment of the business in the annual AGA sales conference on industrial and commercial gas at Cincinnati, April 16-18, and will follow up this event with two affairs in May—the national restaurant show and the commercial gas school.

"Gas for Guns and Butter" is the title of the keynote speech by President George Mitchell of the AGA, which will feature the joint session of the two groups April 17. This meeting is sandwiched between the industrial gas day (April 16) and commercial gas day (April 18), and is devoted to management and sales discussions. "Educating Tomorrow's Customers," presented by Terry Hart of Nashville; "Research Essential to Promotion," by Hale A. Clark of Detroit; and "What Kind of People Can Sell Now," by Fred Smith, Cincinnati, will round out this day's program.

For industrial gas day, talks on gas in the chemical industry, improving load factors through seasonal sales, rapid heating for industrial processing, gas in the rearmament program, industrial fuel engineering as a profession, and gas in the gray iron foundry have been scheduled.

On the commercial gas day program are listed papers on meeting the competition, the competitive picture, service, and a hotelman's view of the gas industry.

Committees of both sections are scheduled to meet the day before the joint conference starts.

For the national restaurant show, to be held May 5-9 at Navy Pier, Chicago, commercial gasmen are anticipating a repeat of last year's success, when 19 manufacturers of heavy duty cooking equipment joined hands in supporting a combined cooking exhibit. More than 18,200 visitors saw that exhibit.

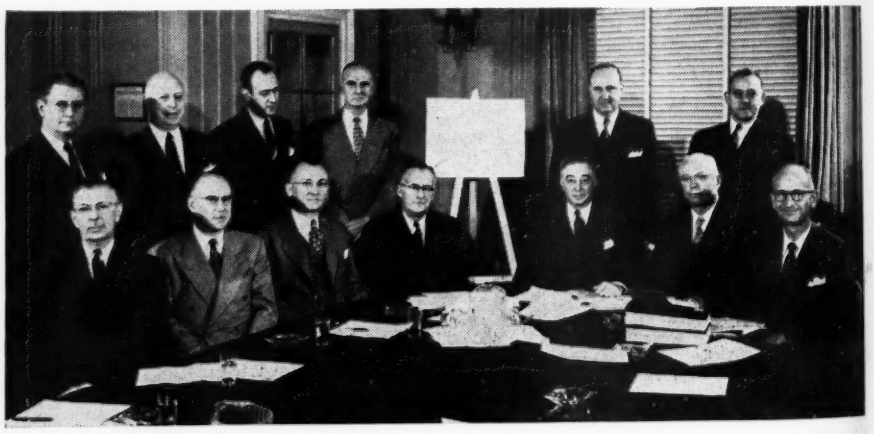
One afternoon of the five-day commercial cooking school, to be held concurrently, will be left free to permit students to attend the show.

New York Accounting Meet Set for April 7-9

A record crowd is expected at the first New York meeting of the National Conference of Electric & Gas Utility Accountants, to be held April 7-9 at the Hotel Commodore.

R. F. McGlone, chairman of the AGA accounting section, and R. H. Smith, chairman of EEI's accounting group, will preside. Scheduled speakers at the first general session include Kinsey M. Robinson, Washington Water Power Co., Spokane; Allan H. Mogensen, New York industrial consultant; and E. R. Eberle, Public Service Electric & Gas.

Various standing committees of AGA and EEI will hold concurrent meetings. These include general accounting, internal audit-



Plans for the October AGA convention were put in motion at a meeting of the general convention committee recently in New York. Attending were (seated) J. L. Johnson, Providence; C. M. Sturkey, Seattle; F. H. Trembly Jr., Philadelphia; K. R. Boyes, AGA; F. A. Lydecker, Newark (chairman); Earl Smith, Atlantic City; W. M. Jacobs, Los Angeles. Standing, Clifford Hall and E. D. Milener, AGA; William Green, Carl Byoir company; G. A. McDonald, AGA; E. L. Henderson, Shreveport; Harold Massey, GAMA.

ing, plant accounting, taxation accounting, depreciation accounting, and customer activities. Separate luncheons are to be held by the customer accounting, customer collections, and customer relations committee.

Financial reporting and accounting techniques will be covered at a general committee session, and open forums and workshops will be conducted with panels comprised of subcommittee chairmen. At an internal auditing committee meeting, with E. R. Mellon, Washington Gas Light, and W. T. Hamilton, Cleveland Electric Illuminating Co., presiding, speakers will be J. B. Jeming, New York consultant; C. J. Nichols, Consolidated of Baltimore; R. T. Hansen, Citizens Gas & Coke Utility; and H. R. Symes, Detroit Edison Co.

Respective AGA and EEI coordinators for all standing committees have planned comprehensive programs at which a host of speakers will discuss all aspects of utility accounting, with special emphasis on customer and employee relations.

Mid-West Sales Group Set For April 21-23 Conference

More than 650 delegates are expected to attend the 26th Mid-West Regional Gas Sales conference April 21-23 at Chicago's Edgewater Beach hotel. The event is sponsored by the AGA residential gas section and is planned by a group of 35 midwestern utility sales managers.

The keynote address, stressing the need for developing and maintaining creative salesmanship, will be delivered by George F. Mitchell, AGA president. Househeating has found a prominent place on the program for the first time in several years, and the importance of selling all domestic appliances will be pointed up by Dean H. Mitchell, Northern Indiana Public Service Co.

Electric cooking competition, automatic clothes dryers, a PAR plan report, cooperation with plumber-dealers, and the value of home service will all vie for attention on the program.

Appliance Society Selects Officers and Directors

Walter S. Newman, Chas. Brown & Sons, San Francisco, was unanimously re-elected president of the Gas Appliance Society of California at its recent annual meeting in San Francisco, and James Graham, Wedgewood Division, Rheem Manufacturing Co., succeeded himself as vice president.

Other 1952 officers are O. R. Doerr, Pacific Gas & Electric Co., secretary; Roy Ohnimus, Western Holly Appliance Co., treasurer; and Walter E. Lind, PG&E, chairman of the executive committee.

Directors include, among others, Seward Abbott, Servel Inc.; Ed Derenia, O'Keefe & Merritt Co.; R. L. Hayden, Coast Counties Gas & Electric Co.; W. F. Lally, Occidental Stove Co.; M. Lannes, Hoyt Heater Co.; W. H. Mixter, H. R. Basford Co.; Ray Oplinger, Tappan Stove Co.; and John S. C. Ross, PG&E.

A spring gas range promotion, to get under way this month, is the first 1952 activity scheduled. A series of cooking schools is to be included.

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—and other increasing costs with a DRAKETOWN PROPANE PLANT. By operating a few days a week or a few weeks a year, it more than pays for itself. As a standby plant, it automatically goes into operation at the turn of a valve.

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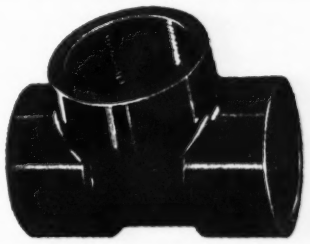

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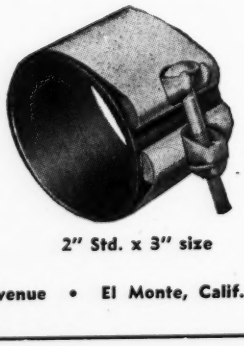

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Solon Chosen to Head AGA Personnel Conference

At a Feb. 21 meeting at Chicago's Palmer House, John J. Solon, Peoples Gas Light & Coke Co., Chicago, was elected chairman of the AGA Great Lakes Personnel Conference. E. G. Huck, Cincinnati Gas & Electric Co., was named vice chairman, and W. K. Paul, Northern Indiana Public Service Co., Hammond, was elected secretary.

Dr. Richard Donham of Northwestern university conducted a discussion of "New Trends in Executive Training," covering planning for executive development, integration of company programs, use of work situation and cases, expansion of university programs, and development of executive skills and attitudes.

Contribution of the Institute of Gas Technology, Chicago, to gas industry progress was told by Dr. Joseph D. Parent of the institute.

Kansas Corrosion School

A two-day cathodic protection institute was held in Liberal, Kan. Feb. 18 and 19 in cooperation with the University of Kansas' "Southwest Kansas Center" at Garden City.

Featured speakers included Jay James, Cathodic Protection Service, Tulsa, who outlined fundamentals of cathodic protection and discussed measurements and applications of it in pipelines and wells; and Yale Titterington, Standard Magnesium Corp., Tulsa, who told about "Applied Cathodic Protection of Pipelines and Wells" and led a round table discussion.

H. V. Anderson, Cities Service Oil Co., Liberal, served as coordinator for the course, which attracted more than 50 representatives from 25 companies in six states.

Consumer Credit Group's Utility Section Expanded

In conjunction with the National Retail Credit Assn.'s 38th international consumer credit conference, to be held in Washington, D. C., June 23-26, a public utility credit and collection group discussion program has been planned by a special utility committee. R. H. Kanies, Milwaukee Gas Light Co., is chairman of the committee, and C. R. Clarke, Brooklyn Union, and W. C. Young, Washington Gas Light, are co-chairmen.

For some time the utilities division has been holding sessions as a part of the credit association's annual meeting, but the program is now being expanded and made an outstanding part of the convention.

Twenty-minute presentations will be followed by open discussion periods. Subjects to be covered include "Credit and Collection Problems in Washington, D. C.," "Operation of the Economic Stabilization Board—Public Utility Branch," "Collection of Off Service Accounts," "Telephone Collection Follow-up," and "Employee Training."

Association Newsnotes

Ernest Szekely, president of Bayley Blower Co., Milwaukee, has been elected 1952 president of the American Society of Heating & Ventilating Engineers. Other new officers are Reg F. Taylor, Houston consulting engineer, first vice president; L. N. Hunter, National Radiator Co., second vice president; and J. Donald Kroeker, Portland, Ore., consulting engineer, treasurer.

American Standards Assn.'s 1951 membership report, released recently, shows that 396 gas companies are included in the association's roster. The valves and fittings industry is represented by 45 companies and one technical society. ASA approved 113 standards last year. New ones of particular interest to the gas industry cover gas unit heaters and automatic pilots.

George Mitchell, AGA president, and Ray J. Vandagriff, vice chairman of the AGA residential gas section, will be featured speakers at the 1952 gathering of the Indiana Gas Assn., scheduled for April 24-25 at French Lick, Ind. Heading the program committee is Edward M. Hahn, president of Kokomo (Ind.) Gas & Fuel Co.

AGA has issued a 101-page roster of the 2500 men and women serving the gas industry through membership on more than 300 committees of the association. The book is titled "Teamwork."

VALVE POSITIONERS

Part 1. Their Applications In the Gas Industry

By C. S. BEARD
Ebasco Services Inc.
New York

Certain operating conditions under which a valve positioner "should be specified" are examined by Mr. Beard in this first installment of a two-part article on this recent addition to gas industry instrumentation.

•

PRESSURE and flow controllers have become a familiar sight in gas meter and regulator stations. The advisability of this refinement to the station instrumentation has been brought about by numerous changes in operation. High transmission and distribution pressures in many cases preclude the use of weight- or spring-loaded regulators. The desire for constant pressures on meter equipment will allow the pressure variations inherent in gas regulators. The practice of limiting the flow to the maximum contractual volume requires the use of a flow controller. For these and many other reasons the metering and regulating station now takes on the appearance of an industrial plant. These changes, as well as the use of specific gravity and Btu recorders, blending equipment, odorizers, diaphragm motor valves with valve positioners, etc., now require that the meter man be a trained instrument man.

The pneumatic controller has been refined to the point where it is capable of producing an output pressure which varies with minute changes of the measured variable in an extremely precise manner. To successfully employ this instrument for accurate control necessitates comparable precision in positioning the device it operates. Thus, if a controller is being used to control the pressure on a gas line, the valve in the gas line must assume the correct position as dictated by the controller in order to increase or retard the flow through the valve. This is necessary so that the success of a system will be comparable to the precision of the controller. The pneumatic valve positioner accomplishes just this when it is applied to the pneumatic supply to the diaphragm of the diaphragm motor valve or to a piston operator.

A typical installation is shown in *Fig. 1*. There are numerous conditions to be found in gas transmission and distribution systems which can be benefited by the use of a valve positioner. The operating condition at which the positioner becomes necessary is difficult to set. In many cases it is a question of "How high is up and if so, how come?" The following are the most important conditions under which this instrument is to be specified.

1. High pressure drop across the valve. Increase in pressure drop decreases the stability of any valve. It is common practice to take pressure reductions considerably above critical when supplying gas from a high pressure transmission line. The advent of the balanced valve has eliminated a large amount of the instability but, even with this type, there is a point at which the normal available diaphragm-area-to-spring-weight ratio is not sufficient to set the valve at exactly the desired opening, particularly as the unbalanced force may reverse during the movement of the valve.

It is difficult to recommend the pressure drop above which a valve positioner becomes necessary. Diaphragm casings are used up to about 300 sq in., which

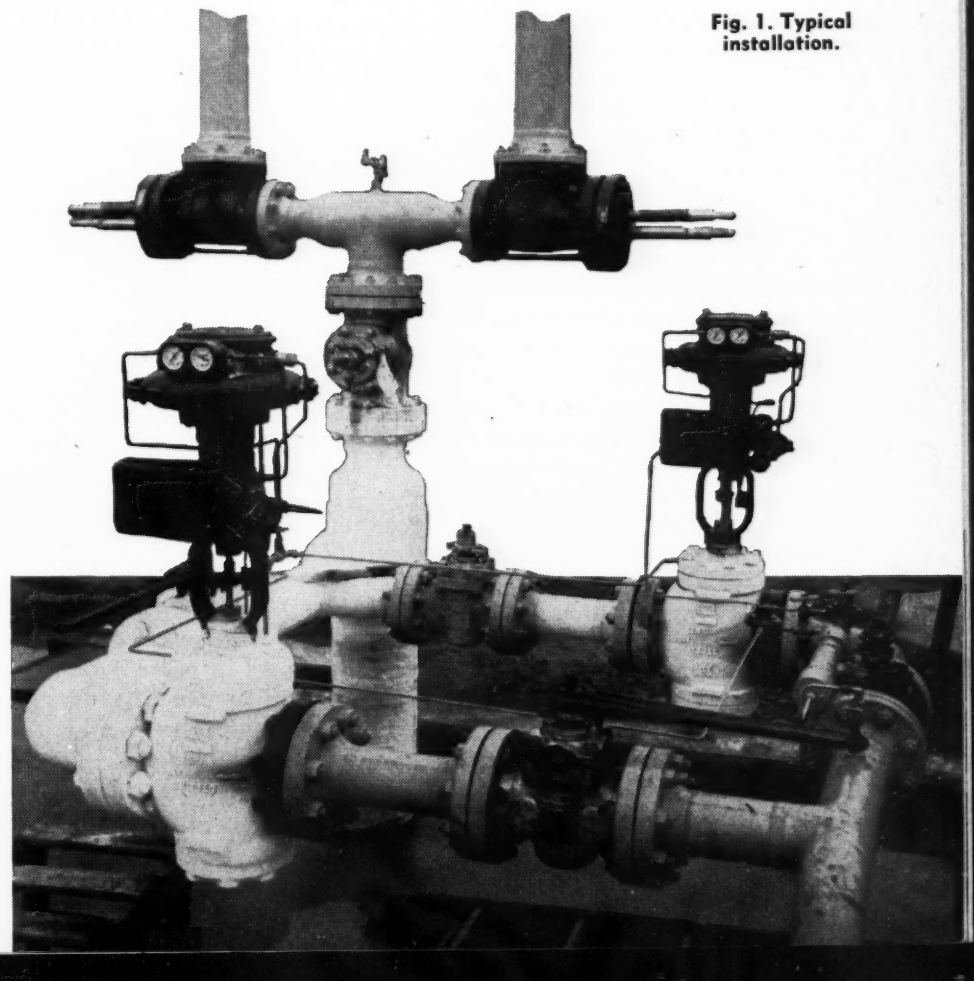

Fig. 1. Typical installation.

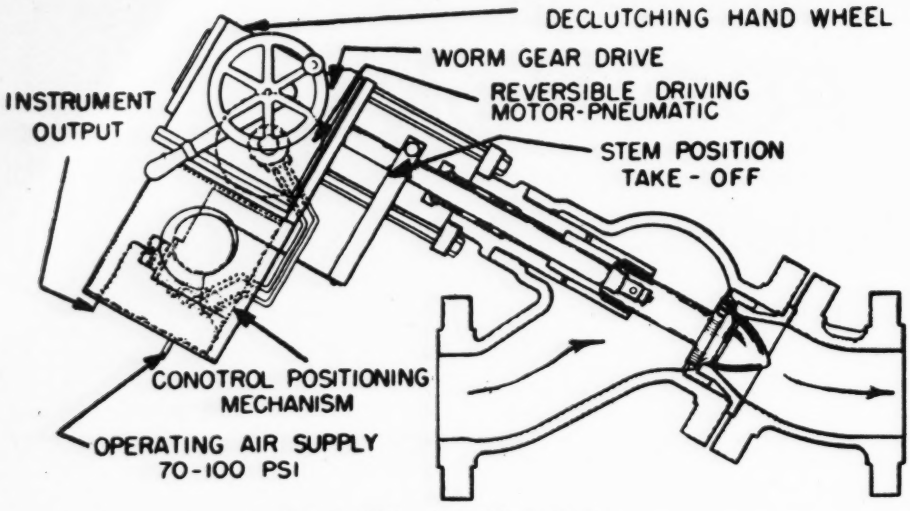

Fig. 2. "S" valve with positioner.

furnish 4500 lb of force with the full pressure of 15 lb, but 600 lb may be necessary to overcome the energy of the spring and another 1000 lb to stabilize the unbalance of the valve. The diaphragm pressure necessary to counteract this unbalance may be determined by multiplying the difference in areas subjected to the upstream and downstream pressures by the pressure drop across the valve and dividing by the diaphragm effective area. Three pounds of diaphragm force is not unreasonable.

The effect of this unbalance varies through the stroke of the valve. Thus an equal change in loading pressure at one point in the stroke would not have the same positioning effect as it would at another point. The valve positioner would overcome this tendency as it sensed valve stem position and set the stem. This is accomplished only when the diaphragm has been selected for sufficient power.

2. Using single seated valves. The use of the valve positioner has made it possible to broaden the usefulness of the single seated valve. The instability of the single seated valve is greater than that of the balanced valve due to increased difference in areas subjected to the upstream and downstream pressures. Larger valves and greater pressure drops may be used succsesfully with a valve positioner as pointed out above.

This type of valve has the decided advantage of tight shutoff, so important in gas distribution systems in which the night load is a very small percentage of the peak load.

Objectionable noise levels and pitch ranges are always a problem to gas companies compelled to place meter and regulator stations in residential areas. The single seated valve adapts itself to venturi and "S" body design. Both of these body designs tend to be more quiet than globe bodied valves. An example of the "S" valve with a positioner is shown in *Fig. 2.*

3. Large characterized port valves. Many of the valves in use in pipeline control have the ports of the valve machined to obtain a particular curve when per cent of maximum port area is plotted against stem movement. The use of a valve with characteristics to fit the requirements of the control system has actually furthered precise control. In order to take advantage of these characteristics it is necessary that there is a true relationship between the output of the controller and the stem position of the control valve. In most cases, a valve positioner is necessary to accomplish this when the valve is a 4-in. size or larger.

4. High pressure applications entailing tight packing. The sticking stem is one of the main conditions which needs a valve positioner. It is very difficult to use most forms of packing to hold high pressure without occasionally causing this sticking condition. This is not due so much to the types of packing available as it is to the aggravated effect of slight misalignment in this design of valve with its close tolerances in guiding. Valves are now available incorporating design features to eliminate packing. Their application has been mostly confined to other than high pressure installations.

5. Valves handling sludge or solids in suspension. It is not difficult to understand the need for valve positioners on valves handling materials that would contribute to sticky stems or guides, or on those handling lumps of material through the ports. This condition is found in the recycling of liquid to a sulfur removal absorber.

6. Non-standard pressure requirement of valve or piston or non-standard output from the controller. One of the few conditions in instrument work that has been standardized by most instrument suppliers is the 3-15 lb range of output from the controller. In most cases the valve is designed with a diaphragm and spring to give full operation with this pressure range delivered to the diaphragm. Many installations. such as the use of a piston operator, are actuated on more than the accepted 15 lb to cause full movement.

The valve positioner may be used to give an output range of, for example, 6-60 lb to the piston with a 3-15 lb change in controller output. The design of the valve positioner will also make it possible to furnish the standard 3-15 lb to a valve with some other range of output from the controller.

7. Reverse valve operation. The valve positioner may be used to obtain decreasing output to the valve diaphragm with an increasing output from the controller. It is recognized that this can be accomplished in most controllers, but systems occur in which it is desirable to have one valve move from closed to open position while another valve is moving from open to closed position.

8. Increase speed of operation. The small volume of the operating bellows of a valve positioner allows it to reflect changes of controller output pressure much more rapidly than would occur if this output were obliged to fill the space in a diaphragm topworks or in a piston. Using higher pressures with a springless operator, the time of operation may be cut to as little as 20% of that of the motor diaphragm valve. For this reason, the valve may be successfully operated at a much greater distance from the controller if a positioner is used.

9. Split range operations. The valve positioner may be adjusted readily to deliver full range of loading of the valve or piston through only a portion of the controller output range. This makes it possible, for example, to supply gas from one source under normal loads, by setting the positioner to open the supply valve fully with a 9-lb output from the controller. The positioner on an auxiliary source would be set to start opening this valve at possibly 8 lb to augment the original gas supply. Innumerable conditions of plant operation may be improved by this method.

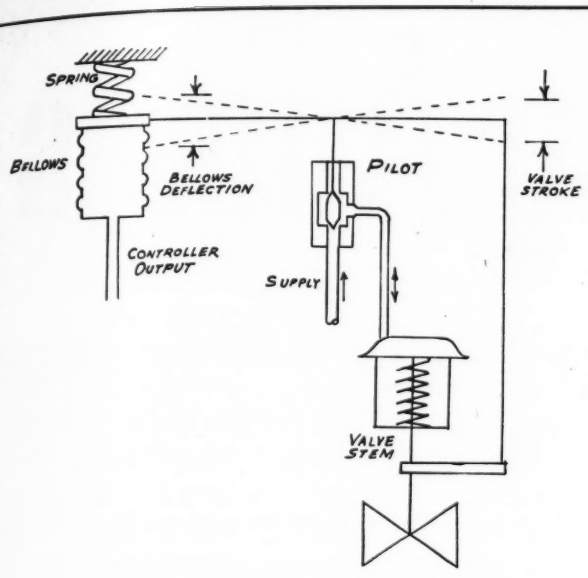

Fig. 3. Proportional deflection balance system.

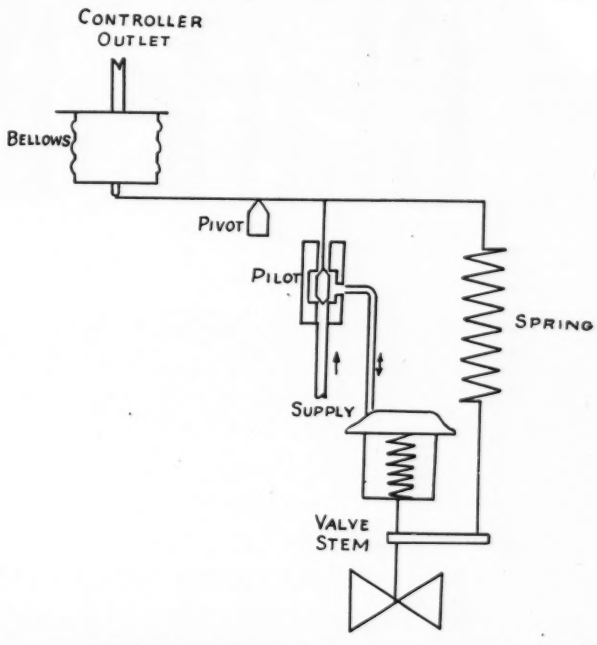

Fig. 4. (right) Pneumatic force-balance principle.

10. Viscous fluids. The use of the valve positioner on valves handling viscous fluids is the same as for sludge.

11. Wide throttling range control operations. Many operations are such that a large deviation from the control point is required to make a small change in the controlled medium. An example of this might be the injecting of an inhibitor into a line. It may not be desirable to make large dosages for short-lived peaks. The small movement of the injection valve for large changes of flow may require a positioner to guarantee that the small movement is accurate. A small amount of hysteresis or friction in the valve might affect this accuracy. The valve positioner facilitates more precise movement of the valve.

This group of uses for the positioner probably includes 95% of the applications encountered in instrumentation design. Within the remaining 5% of the design applications and the daily operation procedures of a plant lie innumerable possibilities for unique and novel methods of utilizing the characteristics of the positioner. This small, inexpensive piece of equipment is an instrumentman's delight. A few of these novel uses will be explained in Part II, following a summary of the equipment available on the market, to appear next month.

Any of the valve positioners available to us from the instrument manufacturers will accomplish the same function, although the design of each one may be different, reflecting the individual talents of the instrument designer. The controlled air output of a pneumatic controller is brought into the positioner. For each output pressure the diaphragm motor valve because of the positioner should assume a definite position. For reasons already outlined, the valve does not always do this. The valve positioner is mechanically connected to the stem of the valve, so that it may evaluate the position of the valve stem and, consequently, the valve position with relation to the controlled air to the positioner. A separate source of air which is fed to the positioner enlists this air to locate the valve at exactly the point called for by the controller.

Two approaches to the design of a positioner have been taken by manufacturers. The proportional deflection balance system is shown in *Fig. 3*. Controller output air deflects the beam. This movement positions the pilot valve to apply pressure on the diaphragm or to bleed pressure from it. The attendant movement of the valve stem deflects the opposite end of the beam. The design is such that the deflection of the valve end of the beam is proportional to the bellows end when the valve is correctly positioned; thus the pilot will open or close to create this equilibrium.

The second system employs the pneumatic force balance principle. In this design, the controller output pressure is applied to a bellows or diaphragm. The movement of the bellows will operate the pilot, which in turn, supplies pressure to the diaphragm of the valve to position the valve. As shown in *Fig. 4*, the movement of the stem causes a spring to create a force to balance the effect of the bellows. These forces are at equilibrium when the position of the valve stem is correct for the existing controller air output. These forces may consist of springs of different tensions, and diaphragms of different diameters, thus eliminating linkages.

Each manufacturer has built his equipment to accomplish the functions of a valve positioner in accordance with his own concept of the best possible design. All are commercially proven. They group themselves rather generally into two types. In the first category are those that convert the controller output to a proportional deflection and compare this to a proportional deflection created by the stroke of the valve stem; among these are the Taylor Precisor, the Brown Valve Positioner, the Foxboro Valveactor, the Bristol Positioner, and the De Zurick Positioner.

In the second category, the type which converts the controller output to a force which can be compared to another force set up by the movement of the valve stem, are the Fisher Positrol, the Bailey Positioner, the Moore Valve Positioner, The Republic Operator, and the Masonielan Valve Positioner.

There are also other positioners which defy classification, such as the Conoflow Rotomotor, the American Meter positioner, etc.

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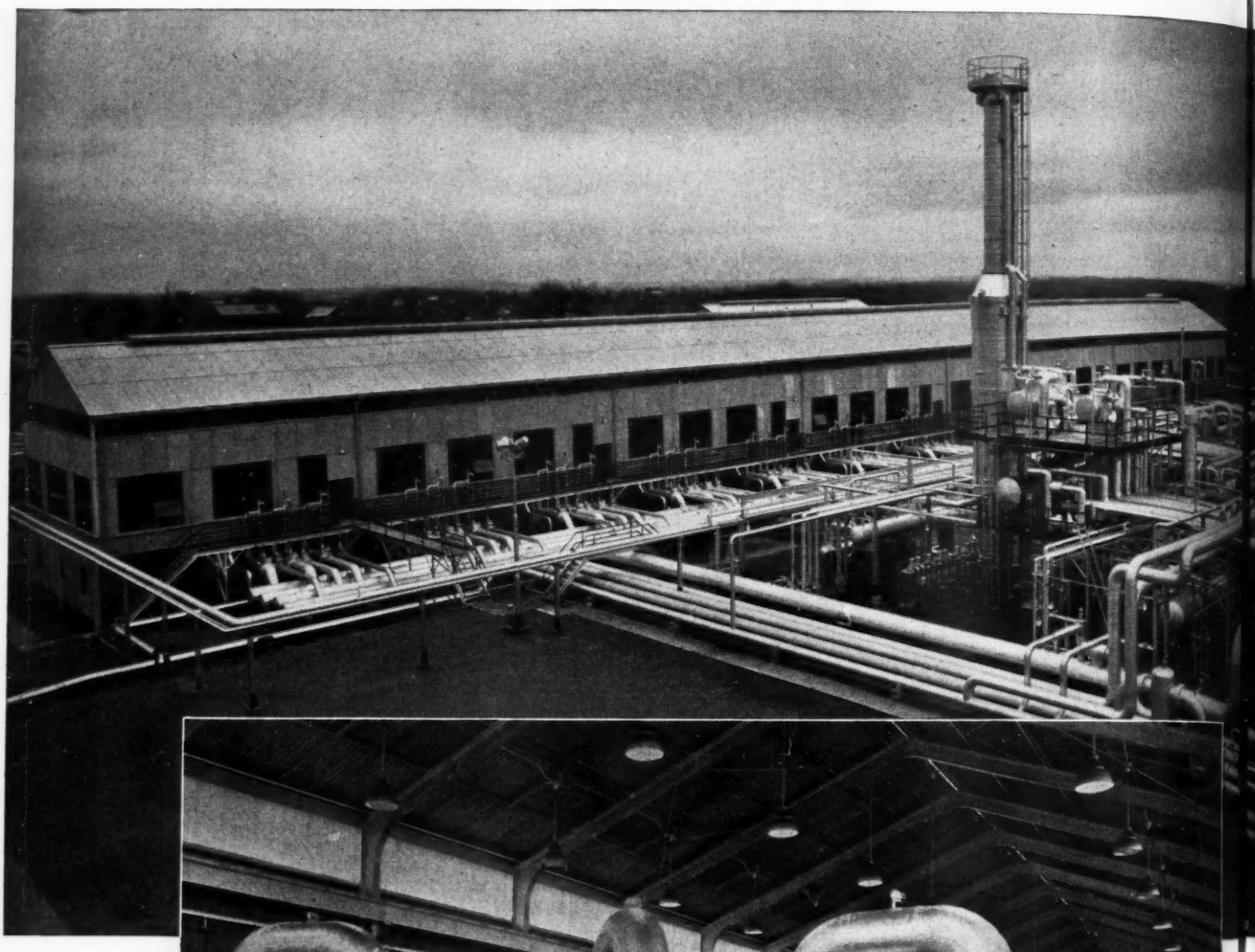
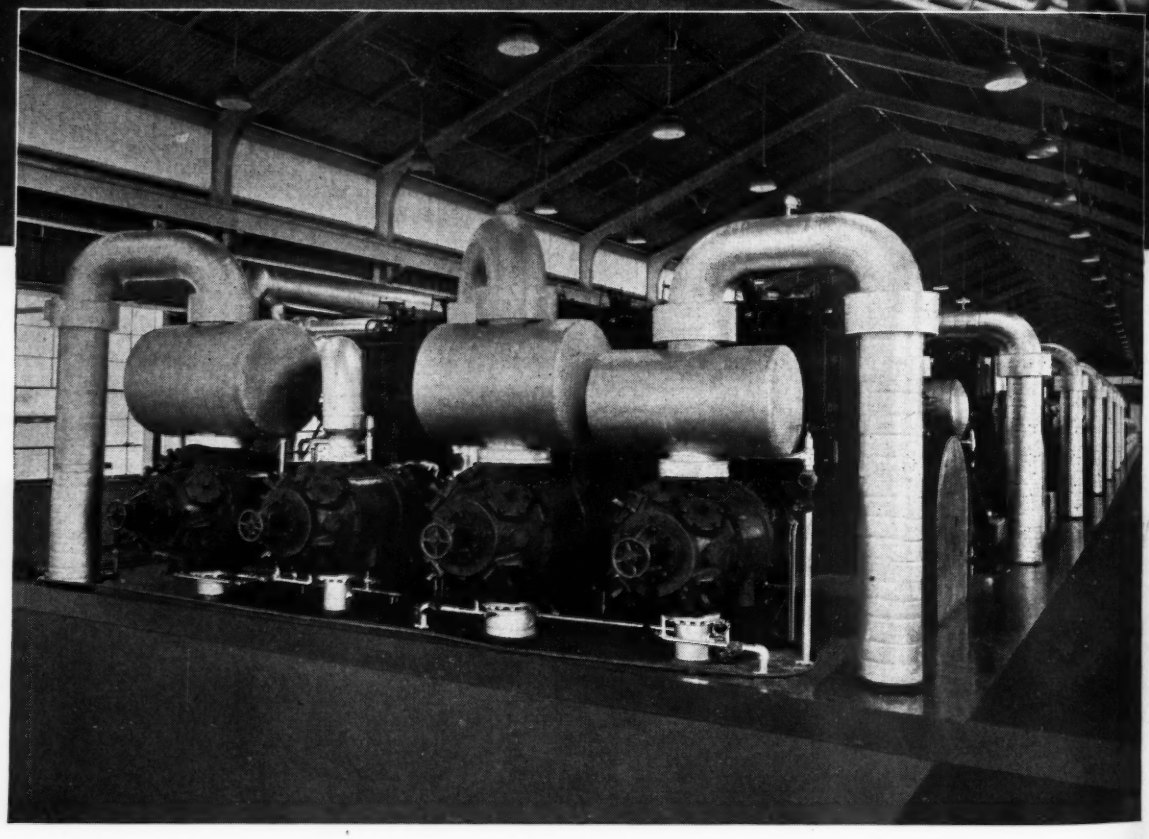
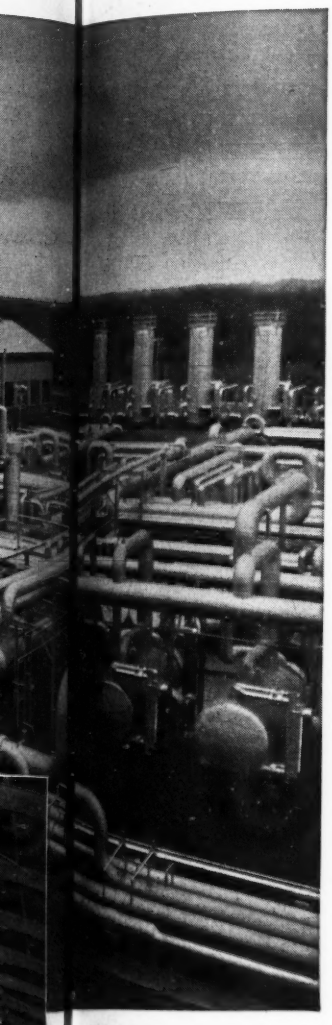
In Part II, to appear next month, Mr. Beard will explain the operation of these various types of positioners and will point out some of the novel uses to which these instruments may be put.

Clark "Big Angles"





score another first!



Clark HBA Compressors, Famed for Sustained Fuel Economy and Dependability, Installed in World's Largest Ethane Recovery Plant

Tennessee Gas Transmission Company recently placed in service the largest ethane recovery plant ever built for operation in conjunction with a gas transmission pipeline. In designing the Gabe, Kentucky plant, process requirements dictated the following rigid compressor specifications:

- A total of 23,000 horsepower required
- 1600 to 1800 horsepower units were necessary for proper compressor distribution between the five compression services
- 750,000,000 cubic feet per day capacity
- Four compressor cylinders per unit
- Minimum fuel consumption was necessary because overall economics indicated an "end of the line" high fuel cost, plant location

With over 135,000 horsepower of Clark BA and HBA compressors already operating in their other compressor stations or on order, Tennessee Gas Transmission Co. knew first hand what the "Big Angle" could do. Thirteen Clark 1760 BHP, High Compression "Big Angles" were subsequently installed to handle all compression services in the new plant. These services include propane refrigeration, ethane refrigeration, reactivating gas service, flash gas service and the return of residue gas to the pipeline.

If you are contemplating building a plant involving intricate processing operations, consult your nearest Clark representative. He has the compressor know-how and a complete line of heavy duty compressor equipment to simplify your installation.

For complete details on Clark Big Angles request Bulletin 104

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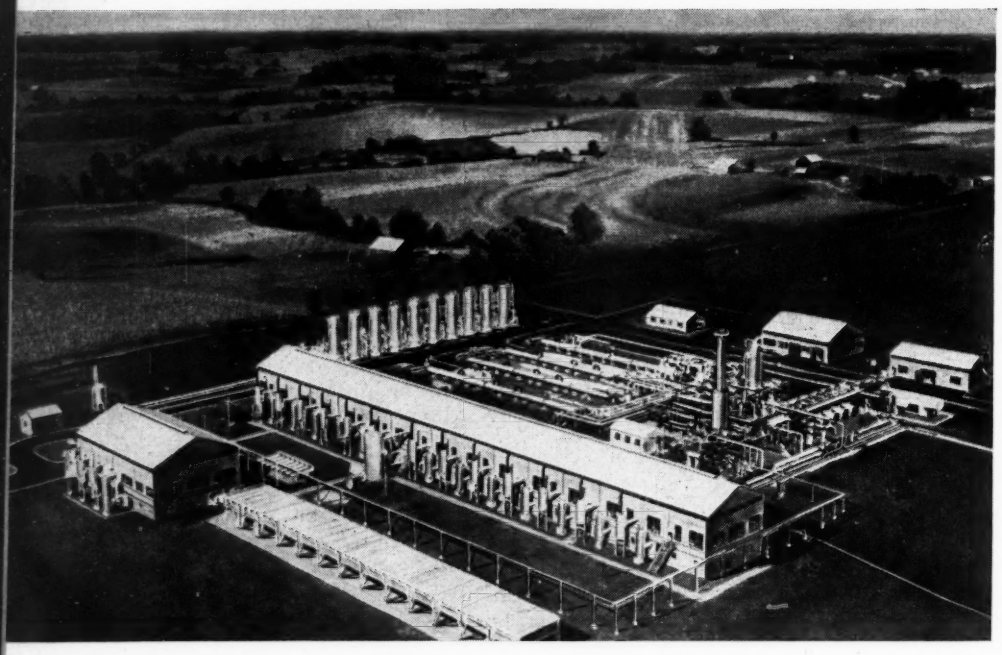
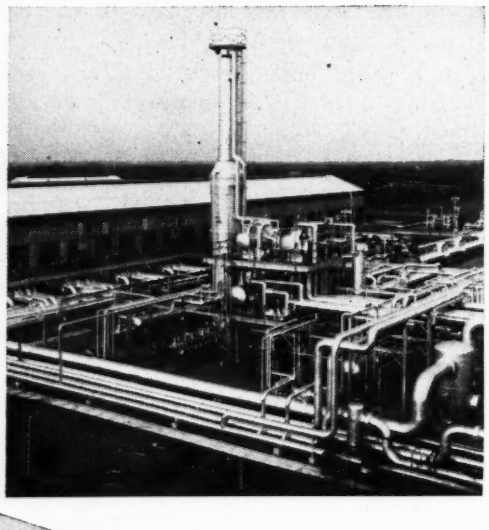
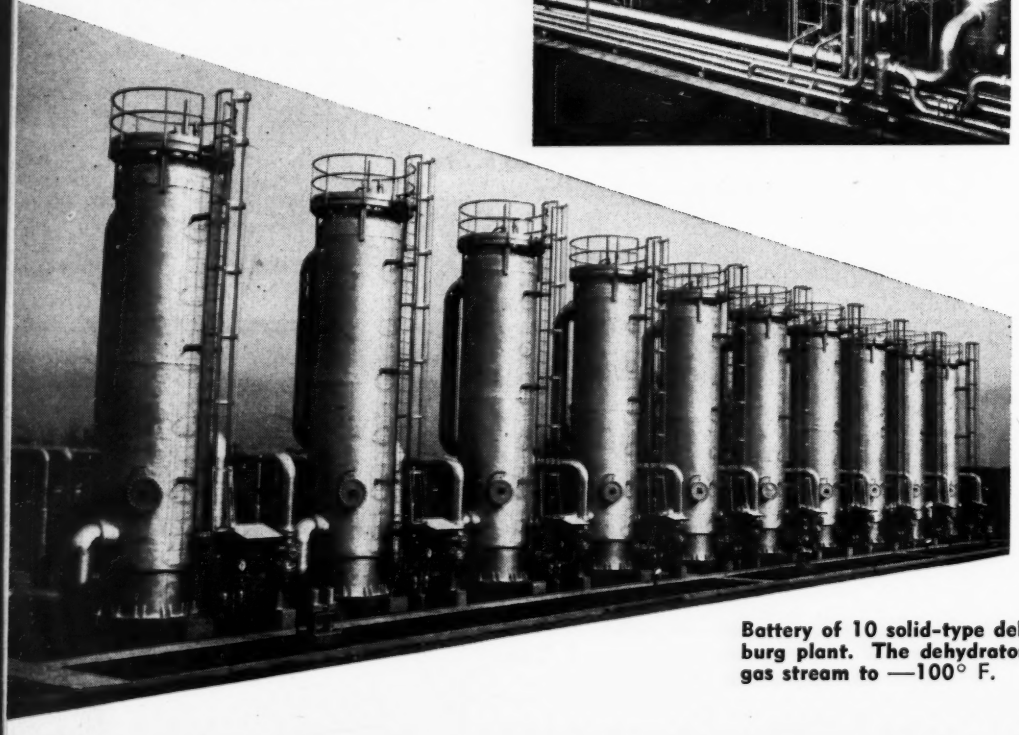
By J. J. KING and R. V. MERTZ
Tennessee Gas Transmission Co.
Houston



Near Greensburg, Ky., Tennessee Gas Transmission Co.'s new liquefiable hydrocarbons extraction plant, the nation's largest, processes 75 MMcf per day, will eventually produce 380,000 gal per day of liquids for conversion to L.P. gas, natural gasoline, and ethane.



Refrigeration area of the plant, showing de-ethanizer tower in the center and compressor building in the background.



Battery of 10 solid-type dehydration towers, part of the Greensburg plant. The dehydrators reduce the dew point of the main gas stream to —100° F.

THE largest gas capacity ever designed for a plant processing natural gas is incorporated in a plant recently completed and put into operation by Tennessee Gas Transmission Co. near Greensburg, Ky. The plant receives natural gas from the company's pipeline, removes ethane and heavier hydrocarbons, and returns the stripped gas to the pipeline. The design capacity of the plant is 750 MMcf per day. Separation of the ethane and heavier hydrocarbons from the gas stream is accomplished by using refrigeration only. Refrigeration capacity required is equivalent to a 12,000-ton-per-day ice making plant.

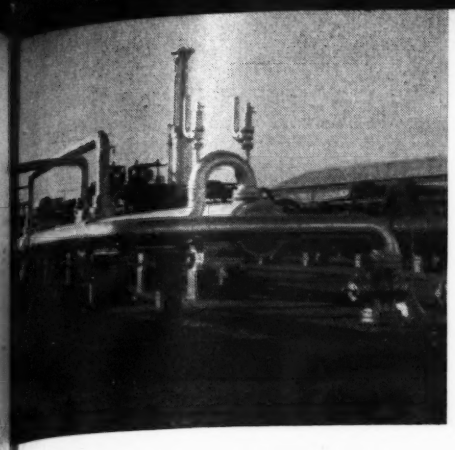
Under normal operating conditions the entire gas stream through the plant will be chilled to 96° F. Liquids previously found to be objectionable to Tennessee's gas customers will be condensed and delivered to a chemical company which will convert them to LPG, natural gasoline, and ethane. Total liquid production will eventually amount to 380,000 gal. per day when the operation has been stabilized and the design quantity of gas is processed.

Unique Arrangement

A unique heat exchanger arrangement is used in order to accommodate the large volume of gas processed. The gas stream from the pipeline is split into four parallel streams through the plant. Heat exchangers 42 in. in diameter are assembled end to end to form the four heat exchanger trains. The long exchanger train arrangement was chosen to simplify the piping and to provide a straight-through path for the gas. This arrangement makes for low pressure drop in addition to the simplified piping arrangement.

Construction of the plant was started in May, 1950. The site near Greensburg was chosen because of the convenience to Tennessee's main transmission line and the chemical plant which will process the extracted liquid stream. Tennessee's ex-

Mr. King and Mr. Mertz are, respectively, vice president and compressor superintendent of Tennessee Gas.



Warm end of feed gas heat exchangers, part of the extraction plant.

traction plant is connected with the chemical plant by a 60-mile long, 8-in. pipeline.

The process utilized to recover the hydrocarbons from the pipeline gas consists basically of only two major operations. The first operation is the separation of the desired hydrocarbons from the feed gas stream. This is accomplished by cooling the gas stream until a sufficient quantity of the hydrocarbons condenses. The second operation involves processing the condensed hydrocarbon liquid to remove unwanted methane and to control the amount of ethane present in the product stream. This is accomplished by flashing the hydrocarbon liquid twice at successively lower pressures and then fractionating it.

Gas entering the plant from the pipeline must be dried before being subjected to low-temperature processing. Eight dehydrators operating on stream in parallel are required to handle the total feed gas flow. A flow controller is provided on the inlet piping to each dehydrator to distribute the flow evenly among dehydrators and to control the total plant throughput.

Continuous Dehydration

Ten dehydrators are provided in order to have eight effective units on stream at all times. Each dehydrator contains a 20-ft deep bed of alumina granules through which the wet gas passes during the drying cycle. Water absorbed during this cycle is removed by taking each dehydrator off stream periodically and passing hot gas through the alumina bed. The reactivated dehydrator is then cooled by passing a cool gas stream through the bed and is ready for return to service. The 10 dehydrators have been designed to permit a continuous operating schedule with eight units always in on-stream condition while the other two are being reactivated and cooled.

Dry gas from the dehydrators at 70° F is cooled to −104° F at approximately 535 psig. Under these conditions about 5.5 mol per cent of the gas condenses. The condensed hydrocarbon liquid is separated and the residual gas, after heat exchange, is compressed to 590 psig and returned to the pipeline.

Four parallel trains of heat exchangers are required for feed gas cooling when the plant is operating at design capacity. Dehydrator exit piping is manifolded in such a way that each exchanger train receives gas from one pair of on-steam dehydrators. Thus, the gas flow through each train is controlled by the setting of the flow controllers upstream of the dehydrators.

In each train these exchangers are bolted end to end, providing straight-through flow for the feed gas on the tube side. The first four shells exchange heat between the incoming warm feed gas and the cold residue gas stream from which the condensed hydrocarbon liquid has been removed. Thus, these exchangers serve the dual purpose of cooling the feed and recovering refrigeration from the residue gas.

The fifth shell in each train employs ethane refrigerant at —96° to furnish the net refrigerating effect required to remove latent heat from the liquid product. The last shell in line recovers refrigeration by evaporating excess light hydrocarbons, principally methane, which were condensed in the high pressure separator.

The hydrocarbon liquid collected in the liquid separator is flashed to a lower pressure. In passing through the expansion valve, a portion of the liquid is vaporized and the stream is cooled by self-refrigeration. The vapor-liquid stream is warmed by heat exchange with the feed, the liquid is separated and flows to the second feed flash operation while the disengaged vapor, after further heat exchange, is compressed and returned to the pipeline.

This series of operations, constituting the first feed flash, is designed to reduce the methane content of the hydrocarbon liquid condensed from the feed gas. The liquid is flashed and heated under conditions which are favorable to the preferential vaporization of methane and which also make possible the recovery of valuable low-temperature refrigeration.

Liquid from the first flash exchanger is flashed to a lower pressure. The residual liquid from the flash is separated from the vapor and is forwarded to the fractionator while the vapor, after heat exchange, is used for plant fuel. While the first flash operation removed a substantial amount of methane from the liquid stream, a further reduction in methane content is necessary.

In the second flash, a methane-rich vapor is removed, leaving a liquid of less than half the original methane content. In principle, the second flash operation is quite similar to the first, but differs in that the addition of heat is not required to secure the desired degree of vaporization.

Second Flash

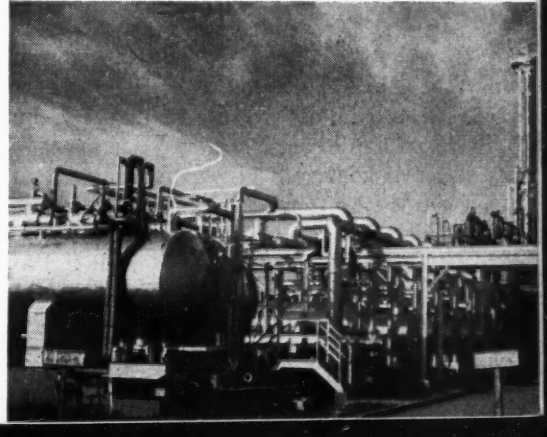
In the second flash operation, first flash liquid at —112° F and 145 psig flows into a common product accumulator which is operated at 40 psig. In passing through the level control valve, the pressure is reduced from 145 to 40 psig, about 15 mol per cent of the liquid is vaporized and the stream self-refrigerates to —121° F.

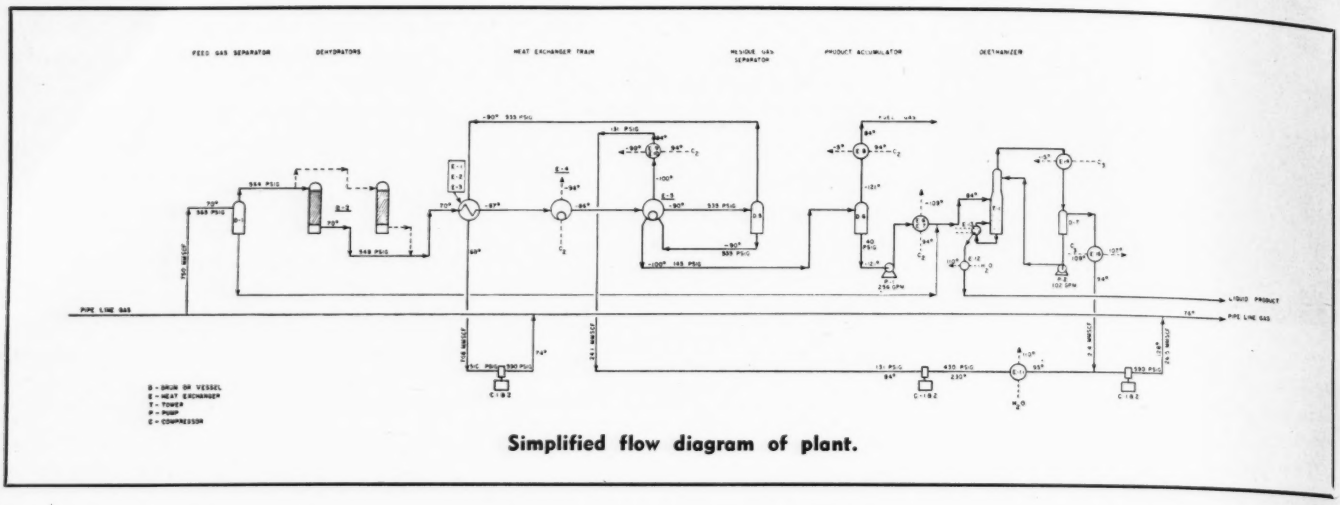
The —121° F vapor-liquid mixture is separated in a product accumulator. The liquid is then pumped to the de-ethanizer, while the —121° F vapor is warmed to 84° F by heat exchange with an ethane refrigerant stream and then flows into the plant fuel system.

Liquid from the product accumulator is pumped through heat exchangers to the de-ethanizer. The tower produces a bottoms liquid product of desired specifications which is cooled and then flows from the plant to the product line. Tower overhead vapor, after heat exchange, is compressed for return to the gas pipeline.

The residue gas stream, the first flash vapor stream and the de-ethanizer overhead must be compressed for return to the pipeline. In addition the dehydrator

Refrigerant storage and refrigerant heat exchangers with de-ethanizer in background.





Simplified flow diagram of plant.

reactivating and cooling gas requires recompressing in order to get it back into the feed gas to the plant.

Six 1760-hp gas engine-driven reciprocating compressors are used for process gas compression. Each of these machines is multi-purpose in that it is designed to handle more than one of the services mentioned above. Four of the machines are each equipped with four compression cylinders. Two of these cylinders are designed for residue gas service, while the remaining two handle the first- and second-stage flash gas services respectively.

The other two machines also have four compressor cylinders apiece. In the latter case the first two cylinders are designed for residue gas compression, the third for first stage flash gas, and the fourth for reactivating gas.

Compressor Speed Control

The speed of each of the compressors is controlled from a common source to maintain the desired plant feed gas rate. The speed control governor on each of the machines is actuated by differential pressure controller. This instrument maintains a fixed pressure drop in the feed gas stream across the feed gas flow controllers and dehydrators by controlling the rate at which residue gas is withdrawn from the process.

In order to secure the desired compression characteristics for the flash gas and reactivating gas services, clearance pockets are provided in all compressor cylinders. These clearance pockets must be manually adjusted to balance compression loads between the three services and insure the desired compression ratio and capacity for each service.

A conventional ethane-propane cascade-type refrigeration system is employed in this plant to provide low level ethane refrigeration at —96° F and intermediate level propane refrigeration at —15° F. Under this system, ethane refrigerant is circulated in a closed system and condensed with propane refrigerant which also circulates in a closed system and, in turn, is condensed with cooling water.

In the ethane refrigeration cycle, liquid ethane flows to the feed gas coolers (and to the de-ethanizer condensers). Exchangers utilize refrigeration available in low-temperature process streams to cool the liquid refrigerant and to reduce the amount of liquid required for a given refrigeration load.

The ethane is vaporized at 19.7 psig and —96° F in the feed gas coolers and the vapor flows through an exchanger to the compressor suction. The ethane liquid-vapor exchanger serves a dual purpose in that it recovers valuable refrigeration from the low-temperature vapor stream and at the same time warms the vapor sufficiently to permit safe operation of the first-stage compressor cylinders. By warming the vapor to —15° F any entrained liquid droplets will be vaporized before entering the compressor. Low-temperature alarms are provided in the ethane compressor suction line. These alarms flash warning signal lights in the control house and compressor house if the vapor temperature drops to —25° F and automatically shut down the compressors if the temperature drops to —50° F.

The ethane vapor is compressed through two stages from 14.8 to 200 psig. Suction pressure is held constant by controlling the compressor speed through the action of a pressure controller. Compressed vapor is aftercooled to 94° F and partially condensed in exchangers. These exchangers utilize refrigeration available in low-temperature process streams to reduce the load on the propane-cooled ethane condensers. Partially condensed ethane is totally condensed at —5° F in the main ethane condensers and returned to the storage tank, thus completing the ethane refrigeration cycle.

Propane Cycle

In the propane refrigeration cycle, liquid propane flows into the interstage flash drum. As the liquid enters this drum, under level control, its pressure is reduced from about 190 to 63 psig, a portion of the liquid is vaporized and the stream is self-refrigerated to 40° F. The refrigeration effect of interstage flash operation improves the efficiency of the propane refrigeration system by reducing the amount of propane which must be circulated through the low pressure side of the system for a given refrigeration load.

Vapor from the interstage flash drum is taken directly into the second stage suction of the propane compressors. In order to avoid the possibility of liquid carryover into the compressors, the flash drum is provided with a metal mesh separator element which will remove entrained droplets and with high-level alarm controllers which guard against liquid overflow. These instruments actuate signal lights in the control room and compressor house if the liquid level rises above normal operating limits and shut down the compressors if the level continues to rise.

Propane liquid from the interstage flash drum flows into the shell side of ethane condensers, the de-ethanizer condenser, and the make-up tower condenser. Individual level controllers mounted on the shell of each of these exchangers govern the rate at which the propane is admitted. Propane vaporized in these units at —15° F and 13.3 psig flows through the propane suction separator into the low-stage compressor cylinders. The separator drum is sized to

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ANALYSIS OF COMPONENTS OF STREAM

STREAM NO	①		②		③		④		⑤		⑥		⑦	
DESCRIPTION	FEED GAS		RESIDUE GAS		SEPARATOR LIQUID		1ST. FLASH VAPOR		1 ST. FLASH LIQUID		2 ND FLASH VAPOR		2 ND FLASH LIQUID	
COMPONENT	MOL/HR	LB/HR	MOL/HR	LB/HR	MOL/HR	LB/HR	MOL/HR	LB/HR	MOL/HR	LB/HR	MOL/HR	LB/HR	MOL/HR	LB/HR
CARBON DIOXIDE	288.2	12,683	247.9	10,910	40.3	1,733	24.7	1,087	15.6	686	4.1	180	11.5	506
NITROGEN	346.0	9,695	339.4	9,510	6.6	185	6.6	185	-	-	-	-	-	-
METHANE	77,359.0	1,240,839	74,565.9	1,196,037	2,793.1	44,802	2,407.6	38,618	385.5	6,184	242.2	3,885	143.3	2,299
ETHANE	2,998.0	90,150	2,268.4	68,211	729.6	21,939	191.1	5,746	538.5	16,193	31.3	941	507.2	15,252
PROPANE	831.9	36,670	359.1	15,829	472.8	20,841	16.5	727	456.3	20,114	2.5	110	453.8	20,004
ISO-BUTANE	148.2	8,612	39.5	2,295	108.7	6,317	1.6	93	107.1	6,224	-	-	107.1	6,224
N-BUTANE	197.7	11,488	29.7	1,726	168.0	9,762	0.8	46	167.2	9,716	-	-	167.2	9,716
PENTANES	90.6	6,536	3.3	238	87.3	6,298	-	-	87.3	6,298	-	-	87.3	6,298
HEXANES	74.1	6,384	1.2	103	72.9	6,281	-	-	72.9	6,281	-	-	72.9	6,281
HEPTANES PLUS	32.9	3,553	0.4	43	32.5	3,510	-	-	32.5	3,510	-	-	32.5	3,510
TOTAL STREAM	82,366.6	1,426,610	77,854.8	1,304,902	4,511.8	121,708	2,648.9	46,502	1,862.9	75,206	280.1	5,116	1,582.8	70,090
GAS VOLUME, MSCF/HR	31,250		29,500.0				1,004.0				106.2			
LIQUID VOLUME, GPM AT 60° F					580.0				307.5				278.0	

remove entrained liquid droplets from the vapor stream and contains a heating coil to vaporize any liquid collected. Hot propane vapor from the compressor second-stage discharge is used as the heating medium in this coil. High-level alarm controllers actuate signal lights in the control and compressor houses if the liquid level rises to a predetermined point and shut down the refrigerant compressors if the separator liquid level continues to rise.

Propane vapor from the suction separator is compressed from 11.8 to 60.9 psig in the first-stage compressor cylinders. Vapor from the interstage flash drum joins this stream in the interstage header and the combined streams are compressed to 200 psig in the second stage. The high pressure vapor is totally condensed in water-cooled propane condensers and then flows into the propane storage drum, thus completing the propane refrigeration cycle.

Refrigerant Compressors

Seven identical 1760-hp reciprocating compressors are provided for refrigerant service. Each machine is equipped with four compressor cylinders, two of which handle the first- and second-stage propane service while the other two are designed for first- and second-stage ethane compression. As mentioned previously, compressor speed is automatically varied to maintain a constant ethane suction pressure. In order to balance ethane and propane compression loads and to secure the desired propane suction conditions, clearance pockets are provided on all compression cylinders.

Separators are provided downstream of the compressors in both the ethane and propane systems. These units are designed to remove lube oil which the refrigerant streams may pick up in passing through the compressor cylinders.

A refrigerant dehydrator is provided for the common use of the two refrigeration systems. This unit contains alumina desiccant for adsorbing water from the refrigerants and incorporates all necessary equipment and controls for reactivating the desiccant and disposing of the adsorbed water.

Facilities have been incorporated in the plant to produce substantially pure ethane and propane for the refrigeration systems. It is estimated that approximately 1 lb per bhp per month of refrigerant will be required to make up for system losses. On this basis, the quantity of ethane required as makeup per month will be about 1500 gal. and the quantity of propane about 1000 gal.

When the plant is in normal operation the refrigerant makeup tower is operated periodically as a batch still to produce ethane and propane makeup for the refrigeration systems. The tower is 24 in. in diameter and contains 15 ft of Berl saddles as packing. It is equipped with a steam-heated reboiler and a propane-refrigerated reflux condenser. A differential pressure controller maintains a constant pressure drop across the packed section to prevent flooding by acting in conjunction with a flow controller to control reboiler heat input. Feed for the makeup tower is taken either from the de-ethanizer reflux or bottom product, from the de-ethanizer reflux when ethane is to be made and from the bottom product when propane is to be made.

The fire protection system consists of two Underwriters-approved fire pumps taking suction from the storage tank gravity feed line and discharging to an underground grid system of piping with hydrants and small hose cabinets at strategic locations in the process and residence areas.

Each fire pump is rated at 500 gpm with a discharge head of 100 psig. One pump is electric motor drive and one gasoline engine drive. Both pumps are manually operated from the water treating building and the grid system is under pressure only when the pumps are in operation.

Steam is supplied by a package-type steam generating unit. This unit consists of boiler, combustion equipment, mechanical forced draft, and boiler feed water return system complete with necessary fittings and controls. The natural gas-fired, water tube-type boiler has a rated capacity of 12,000 lb per hr of steam from and at 212° F. Its maximum pressure rating is 160 psig but it will normally operate at or below 100 psig.

Condensate is returned under steam pressure from the steam traps to the vented condensate receiver and is pumped into the boiler by the boiler feed pumps. Treated water is used for boiler feed makeup.

Source of Fuel

Process vent gas streams constitute the normal source of plant fuel. The compressor fuel system operates at 25 psig and receives most of its fuel from the second flash vapor stream. However, this stream is insufficient to meet the total compressor fuel demand, so a small portion of the first flash vapor stream is used to make up the deficit. A pressure controller allows enough of the 135 psig first flash vapor to bleed into the compressor fuel system to maintain the desired 25-psig pressure in that system.

The auxiliary system normally receives all its fuel from the first flash vapor stream. The 135-psig gas is taken from the flash vapor compressors' first stage suction header, throttled through a pressure controller, and distributed through the system at 25 psig. Gas is piped at 25 psig to the reactivating gas furnace, employees' cottages, calorimeter building, the office building, warehouse, garage, and water treating building. A second pressure regulator reduces the pressure to 1 psig for use in the electric generators and the auxiliary building heating system. An emergency and makeup fuel supply is furnished from the feed gas to the plant through a pressure controller which reduces the pressure from the main line pressure to 25 psig.

Water is drawn from the Green river through twin intake caissons and is pumped to a 300,000-gal. capacity storage tank near the plant site by means of

NORMAL OPERATION		FUTURE OPERATION				INITIAL OPERATION											
⑧		⑨		⑩		⑪		⑫		⑬		⑭		⑮		⑯	
DEETHANIZER OVHD.		DEETHANIZER BTMS.		DEETHANIZER OVHD.		DEETHANIZER BTMS.		DEETHANIZER OVHD.		DEETHANIZER BTMS.		GAS RETURNED TO PIPE LINE					
												INITIAL		NORMAL		FUTURE	
MOL/HR.	LB/HR.	MOL/HR.	LB/HR.	MOL/HR.	LB/HR.	MOL/HR.	LB/HR.	MOL/HR.	LB/HR.	MOL/HR.	LB/HR.	MOL/HR.	LB/HR.	MOL/HR.	LB/HR.	MOL/HR.	LB/HR.
9.2	405	2.3	101	5.7	250	5.8	256	11.1	489	0.4	17	281.2	12,375	279.3	12,291	275.8	12,136
–	–	–	–	–	–	–	–	–	–	–	–	345.3	9,676	345.3	9,676	345.3	9,676
129.8	2,083	13.5	216	123.3	1,978	20.0	321	143.3	2,299	–	–	76,870.6	1,233,004	76,857.1	1,232,788	76,850.6	1,232,683
128.2	3,860	379.0	11,392	11.0	331	496.2	14,921	484.2	14,572	23.0	680	2,924.1	87,942	2,568.1	77,230	2,450.9	73,701
–	–	453.8	20,004	–	–	453.8	20,004	19.7	867	434.1	19,157	393.6	17,329	373.9	16,462	363.9	16,482
–	–	107.1	6,224	–	–	107.1	6,224	0.8	44	106.3	6,180	31.7	2,421	40.9	2,377	40.9	2,377
–	–	167.2	9,716	–	–	167.2	9,716			167.2	9,716	30.4	1,766	30.4	1,766	30.4	1,766
–	–	87.3	6,298	–	–	87.3	6,298			87.3	6,298	3.3	238	3.3	238	3.3	238
–	–	72.9	6,281	–	–	72.9	6,281			72.9	6,281	1.2	103	1.2	103	1.2	103
–	–	32.5	3,510	–	–	32.5	3,510			32.5	3,510	0.4	43	0.4	43	0.4	43
287.2	6,348	1,315.6	63,742	140.0	2,559	1,442.8	67,531	659.1	18,251	923.7	51,839	80,881.8	1,364,897	80,499.9	1,352,994	80,362.7	1,349,205
101.2		244.0		53.0		264.0		250.0		181.3		30,620		30,550		30,420	

two vertical turbine-type deep well pumps. Each pump has a capacity of 200 gpm at a discharge pressure of 140 psig.

One pump has an electric motor drive, the other a combination electric motor and gasoline engine drive with disengaging clutch. It is intended that one pump will carry the normal load although the pumps may be run in parallel if required. Pump operation on electric motors is by means of an altitude controller actuated by the head of water in the tank. The gasoline pump, for use when electric power is off, is manually controlled.

From the storage tank, water flows by gravity to the water treating building where it is treated for boiler makeup, jacket cooling, and building service.

Cooling Towers

A two-cell, induced draft, coil shed-type cooling tower is utilized to cool about 6000 gpm of water from 102° F to 84° F. The major portion of the cooled water is passed over atmospheric cooling sections located within the tower structure, collected in a sump, and recirculated to the top of the tower. The remainder of the cooled water is collected in a separate sump, pumped through the plant cooling water circuit, and returned to the top of the tower.

Raw water from the water storage tank is utilized for makeup. Sulfuric acid and chlorine are metered into the cooling water system at different points to precipitate solids and inhibit algae growth respectively. A continuous blowdown of approximately 25 gpm is maintained to prevent solids buildup in the system.

Cooling water is circulated in a closed system through engine jackets, lube oil coolers and the first stage flash gas and propane compressor cylinder jackets. All other compressor cylinder jackets are individually equipped with thermal siphon cooling systems which are filled with ethylene glycol solution.

Approximately 10,800 gpm of water at 160° F is circulated by the jacket water pumps. Of this total, 3195 gpm is cooled to 120° F in air-cooled exchangers and then flows through the lube oil coolers. Water leaving the lube oil coolers at 126° F is blended with the balance of the 160° F water from the jacket water pump discharge to give about 10,800 gpm of 150° F water for engine and compressor cylinder jacket cooling. This water returns to the engine jacket water surge tank at 160° F for recirculation through the system.

Flow Controls

The jacket water system is provided with controls which will automatically maintain proper flow quantities and temperature levels. A temperature controller maintains a constant temperature of 150° F in the blended stream to the engine jackets by controlling the amount of 160° F water which enters the stream. Another temperature controller insures that the temperature of the lube oil cooler stream does not drop below 120° F by adding 160° F water, as required.

A differential temperature controller maintains a constant 10° differential between water entering and leaving the engine jacket by controlling the total amount of water circulated.

A starting air system at 225 psig is maintained for starting the gas engine-driven compressors and generators. Two starting air compressors and eight receivers are provided. Both compressors are equipped with electric motor drive, one of them having a standby gas engine drive as well.

Utility air-hose connections are provided on the starting air lines at convenient locations in the compressor house and auxiliary building.

Instrument Air

The instrument air system consists of a motor-driven compressor, aftercooler, receiver, filter, and package-type dehydrator. Dry air at 60 psig is distributed to instruments and also utilized for pressuring the treated water storage tank. A connection from the starting air system, with pressure-reducing valve insures continuity of the instrument air supply in event of compressor failure.

Power for the operation of the plant is obtained from three gas engine-driven generators located in the auxiliary building. The gas engines are 880-hp, 8-cylinder, 327-rpm, each one direct-connected to and driving a generator rated 750 kva, .8 pf, 480 volts, three-phase, 60 cycles, with a 15-kw, 125-volt 1750-rpm exciter driven from the generator shaft by means of a V-belt.

Two separate ignition systems for the gas compressors are provided, each of which originates at the main 480-volt bus. In the main 480-volt switchgear, the voltage of each ignition circuit is reduced from 480 to 120 volts, three-phase, by means of two sets of small transformers. One circuit from each set of transformers runs in underground duct to the compressor house where the voltage is further reduced to 12 volts, and at that voltage the current is rectified by means of two full-wave metallic rectifiers.

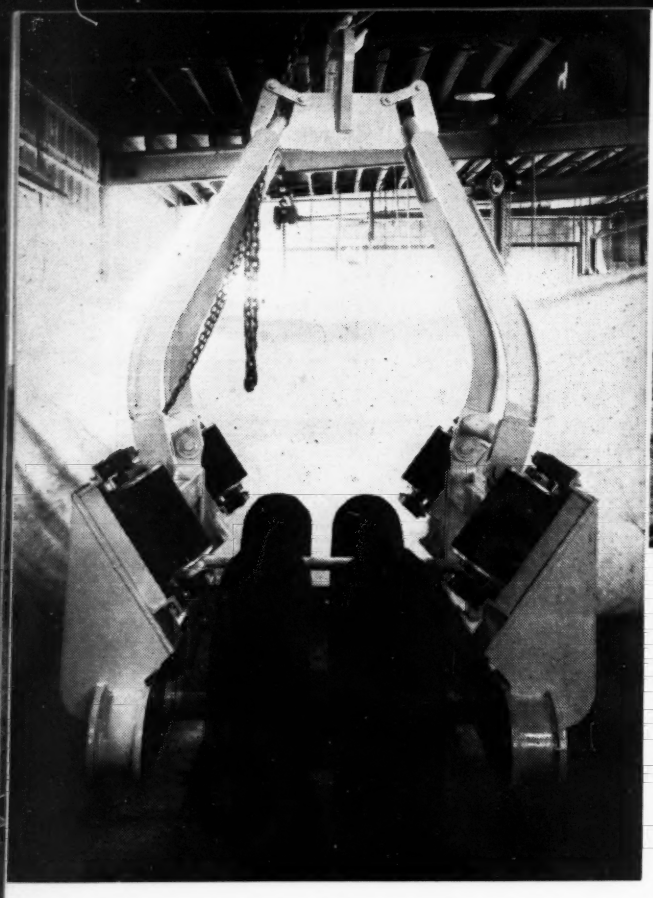
The 12-volt d-c from each rectifier unit goes to a three-wire bus, having a common neutral. The ignition system of each compressor gas engine may be switched selectively to either source of ignition power, and indicating lights are provided for indication of the system to which the compressor is connected. An ignition and control board is provided for each compressor.

Automatic Shutdown

Provisions are made for automatic shutdown of all compressors from several process control points in the event of an emergency.

A sound-powered telephone system has been provided with stations in the office building, change room, control house, compressor building, and auxiliary building. The cable for the telephone system is run underground between stations.

The plant was designed and constructed by Stone & Webster Engineering Corp., Boston.



The cradle in action (above). Only one other sideboom is necessary for quick, gentle lower-in.

End-view of the cradle (left). Large rubber tires and rubber rollers mounted on sides of frame provide smooth cushion for pipe, protect enamel coating.

Pipeliner's Cradle

PIPELINERS of Panhandle Eastern Pipe Line Co. and of such contracting firms as R. H. Fulton Co. and Mahoney are whistling lullabies now that the pneumatic lowering-in cradle has become a standard piece of equipment.

The device, invented and perfected by Panhandlers, is speeding pipeline laying and clipping labor and equipment-use costs by as much as $400 a mile for the Kansas City transmission company. By eliminating the leap-frogging technique required when slings are used for lowering-in, the cradle has eliminated one sideboom and has chopped 50% off the operation's time.

Replacing the sling, the cradle, suspended from the boom, fits snugly around the pipe. As it's moved along, the pipe, riding on four large airplane type tires and four hard rubber rollers set into the inner sides of the frame, unrolls easily into place in the trench. When two cradles are set up in series, the lowering-in is set to go in one continuous operation.

With the conventional sling method, at least three tractors are needed, even in the best terrain, two for lowering-in and a third which merely holds the pipe on skids. After No. 1 has completed its job, it leap-frogs to the head of the line and becomes No. 3. Unhooking of belts and maneuvering of the No. 1 tractor is a time-consuming task. On such a job, only two sidebooms would be required if the cradle were used.

The cradle is easily set in place and removed. One of the arms which encircle the pipe can be unfastened at the top and swung outward, permitting the cradle to be slipped around the pipe. It is ordinarily removed by running it off the end of the pipe.

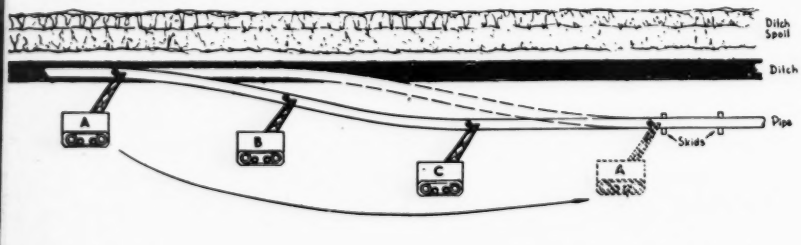
Today's cradle is a substantial improvement over the one on which Steve Bergman and Charles King of Panhandle Eastern began working in the summer of 1948. A stout boxlike structure, it was first put to work in 1949 on the Louisburg loop, where it did a creditable job, although some difficulty was experienced with the rubber rollers, which showed a tendency to collapse and permit the pipe to rub against the frame. Resetting of the rollers quickly solved this problem.

During construction on Panhandle Eastern's line in late 1951, 10,000 ft of 24-in. pipe was lowered in one 61-minute period and 11,000 ft of 18-in. was set in place in 70 minutes.

Patented by Panhandle, the cradle is presently being manufactured by Perrault Bros., Tulsa.

Presented through the courtesy of *Panhandle Lines*, employee publication of Panhandle Eastern Pipe Line Co.

With conventional method, three or more tractors are used. Tractor C holds pipe on skids while A and B lower; A then moves to head of line, during which time forward progress stops.



With the cradle, both tractors move steadily ahead parallel to the ditch. Switching of tractors and fastening and unfastening of belts are eliminated.

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Line Pipe

Manufacturing Processes

Properties

Stresses in Service

By KARL L. FETTERS

Youngstown (Ohio) Sheet & Tube Co.

1. Manufacturing Processes

Seamless

OF the line pipe manufacturing processes in use today, the seamless process is the oldest. Until about 60 years ago seamless tubes were made by piercing a round hole along the central axis of a round bar or billet which was then rolled and drawn over mandrels to form a tube. Since sometime in the 1890's most of the seamless tubes have been made by the rotary piercing process. Basically, this process consists of rolling a round bar or billet on conventional rolling mills, cleaning up the surface of the round by accepted conditioning practices, and then heating preparatory to the piercing process.

Fig. 1 shows schematically the piercing of a heated round. Here the round is forced to enter the space between two barrel-shaped rolls. The two rolls are set on axes which are inclined to one another and they are revolving in the same direction. After the round has entered the "pass" of the piercer, it is pulled through the mill by the inclined rolls which at the same time, by their rotary action and pressure, cause a cavity to be opened in the center of the round. It is not easy to visualize the stresses which cause this cavity to open, but in *Fig. 1* the piercer point supported on a mandrel between the rolls can be seen. The advancing round is pierced and the wall thickness roughly controlled as the tube passes over the point.

As the rough pierced tube leaves the piercer it is heavy walled and usually either larger or smaller than the intended finish size. It would take too long to describe here in detail the subsequent rolling operations by which the tube reaches its final shape and size. These rolling passes elongate the pierced shell, reduce its wall thickness, and control its outside diameter. In most of the rolling operations the inside is supported by a ball, point, or mandrel.

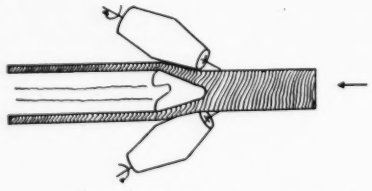

Fig. 1. Seamless method.

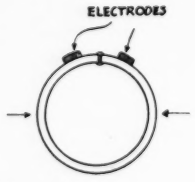

Fig. 2. Electric flash welding.

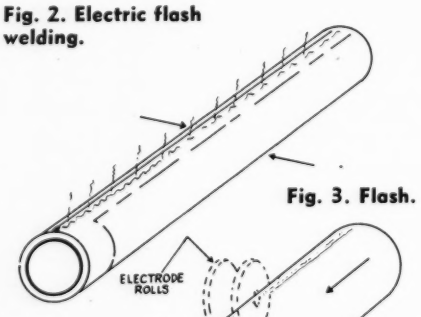

Fig. 3. Flash.

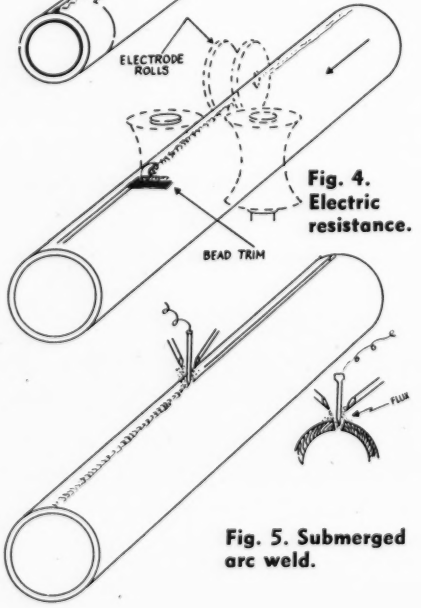

Fig. 4. Electric resistance.

Fig. 5. Submerged arc weld.

Seamless line pipe is made in sizes ranging from 6⅝-in. OD up to and including 26-in. OD. As to grade, almost any steel composition can be made into line pipe by the seamless process and about the only limits of properties are those imposed by field welding and field service. Seamless line pipe is commonly furnished in Grade B, X-42, and to a lesser extent as X-46 and X-52.

Mill Welding Processes

The operation that mill welding processes have in common is the hot rolling of the plate or skelp on conventional plate or strip mills. After the required shearing of the edges and the ends, the flat skelp or plate is cold-formed into a cylindrical shape. In the submerged arc and the electric flash welding processes the forming and the welding are usually done on completely separated units, whereas in the electric resistance welding process the forming mill and the welding mill are usually an integral unit. For the submerged arc process either bending rolls or press forming are commonly used.

Most of the pipe made by the electric flash weld process is press formed. A forming mill is usually used with the electric resistance weld process. Here the flat plate is gradually shaped into pipe in a series of continuous roll passes and as the almost-closed cylinder emerges from the last forming pass it enters the welder.

The same general types of steel may be used in any of these processes. In all cases they must be of a "weldable" grade, which limits their chemistry and properties somewhat as compared to the seamless process. Although there are limita-

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tions of OD size and wall among the individual mills making pipe by these welding processes, pipe as large as 36-in. OD could be made by any of the processes and pipe as small as 6⅝-in. OD can be made by any except the submerged arc. Here the practical limit of minimum OD is said to be about 12¾-in. OD since the ID must permit passage of the welding head to apply the inside bead. I do not believe much pipe under 20-in. OD has been made by this process.

Electric Flash Welding

In electric flash welding the formed cylinder is held in a die during welding. The electrodes make contact on either side of the open seam, the edges of which just touch. In this process the entire length of the pipe is welded at one time. In *Fig. 2* the relative positions of the electrodes are shown. A low voltage, high current (up to 1 million amp.) is applied which brings the edges of the plate to a welding temperature. At the proper time and temperature, the voltage is reduced and force is applied by the die to weld the edges and to "extrude" the bead. *Fig. 3* is a perspective schematic diagram of the process.

Following the welding, the current is cut off and the pipe is held in the die until the weld cools. In subsequent operations the excess "bead" is removed by cutters and the pipe is finished by methods which are common to all welding processes and which will be described later.

Electric flash welded pipe is available from 8⅝-in. to 34-in. OD in 0.250 to 0.500-in. wall thickness.

Electric Resistance Welding

Forming and welding are usually done in the same mill in the electric resistance welding process. *Fig. 4* shows schematically a tube entering the welder from the forming mill. Here the low voltage (about 5 volts), high amperage current (about 300,000 amp.) enters the pipe on either side of the seam through a pair of insulated copper electrode rolls. Welding pressure is applied by the side rolls shown and frequently by an inside mandrel ball which is on the inside of the pipe immediately beneath the electrode rolls.

It is common practice in the manufacture of resistance welded pipe to trim both the inside and the outside beads as the pipe emerges from the welder. In the figure, the outside bead trimmer is shown while the inside trimmer is supported by the same mandrel that supports the inside ball. Several sets of "pull out" stands of rolls usually serve to pull out and guide the pipe from the mill. Further finishing operations are similar to those used in the other welding processes.

Electric resistance weld pipe is available from 6⅝ to 22-in. OD and from 0.188-in. to about 0.400-in. wall. The ranges of any particular mill will generally not cover the entire range of sizes.

Submerged Arc Weld

The submerged arc weld, often called the fusion weld process, is quite familiar from its universal use in the shops and fields for all kinds of structural welding. Basically it consists of an automatic welding head (see *Fig. 5*) which moves along the seam at a constant speed. Quite obviously either the pipe or the welding head may be moved. The welding head carries a large coil of bare wire, one end of which functions as one electrode while the plate serves as the other electrode.

The wire is automatically fed at a rate determined by the current, voltage, and weld characteristics desired and the welding head speed is controlled to make a satisfactory weld. In the submerged arc process flux in powder form is fed in a continuous stream around the electrode wire and forms a shield against oxidation of the weld metal. The slag formed also serves to prevent rapid chilling of the weld area.

In this process the bead is generally not trimmed but otherwise the finishing operations are similar to those of the other welding processes.

Fusion weld pipe is available from 0.188 to 0.500-in. walls and from 36-in. OD down to the practical limit for welding an inside bead, which presently is about 20-in. OD.

2. Properties

Chemistry Specifications

The chemical composition of line pipe steels cannot be discussed without consideration of the mechanical or physical property requirements. The strength of these steels is dependent primarily upon their chemistry. Since all of the standard line pipe steels are plain carbon steels, it will be sufficient to consider only the elements carbon, manganese, and phosphorus. Although phosphorus is sometimes used for its strengthening effect, a consideration of only the carbon and the manganese will be sufficient for our discussion.

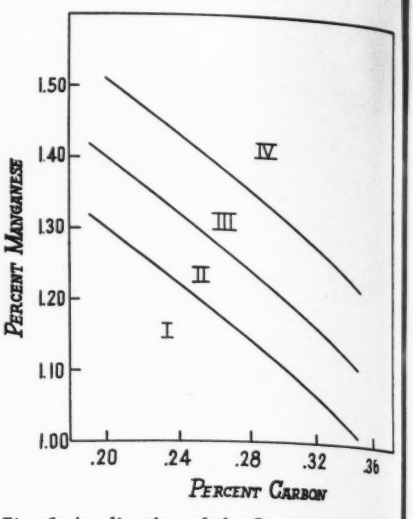

Fig. 6. Application of the Grossman method.

Carbon is a very potent strengthener and is used to increase the strength as much as possible. The practical limit of carbon is dependent upon the field requirements for weldability and the specification requirements for ductility. Manganese is not as potent a strengthening agent as carbon, but its presence adds to the workability of the steel in forming and rolling, and, in general, increasing the strength of a steel with manganese means less sacrifice in ductility than when the same gain in strength is accomplished with carbon. As in the case of carbon, a compromise must be reached between the strengthening effect of manganese and its adverse effect on weldability.

Limits of chemical composition for line pipe are given in the March 1951 issue of API Standard 5 LX only for X42 grade. These limits for carbon and manganese limit these two elements respectively to 0.33 maximum per cent and 1.28 maximum per cent based on check analysis. Chemical limits for the higher strength grades are not given, and the specification says that they are subject to agreement between the purchaser and the manufacturer.

As we have already mentioned, steel is strengthened chiefly by the carbon and the manganese, and, since the higher strengths than X42 may be attained by different processes, as will be discussed later, it is not practicable at this time to limit the chemical composition of the higher strength grades.

Mechanical Properties

The usual mechanical or physical property requirements of line pipe are covered in detail in API 5XL. The standard ten-

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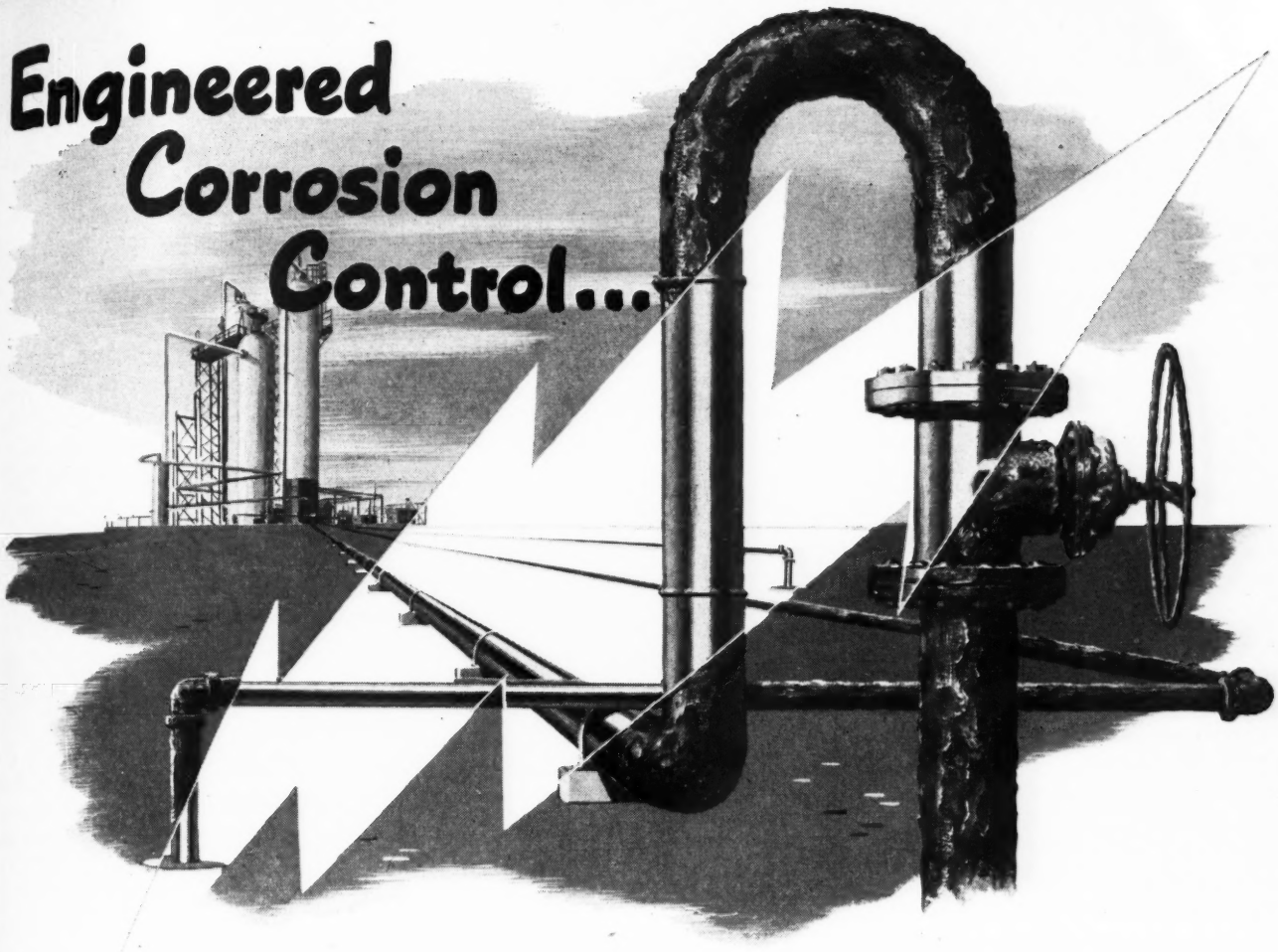

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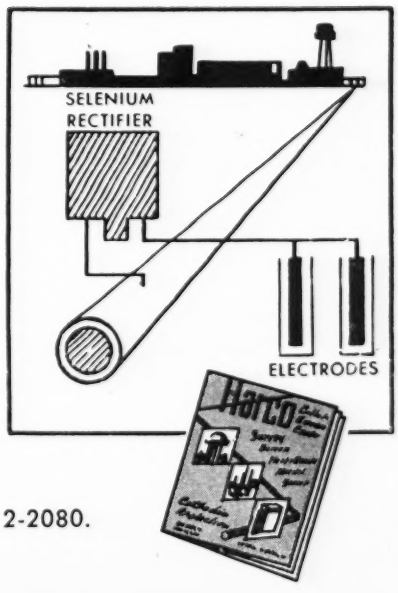

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sile samples are expected to show a minimum yield strength of 42,000 psi, a minimum tensile strength of 60,000 psi, and a per cent elongation in 2 in. of 22.50% minimum for a typical wall thickness (0.250-in. wall). It is also required that the pipe be subject to hydrostatic test where the pipe is stressed circumferentially to a fiber stress equivalent to 85% of the specified minimum yield strength.

As in the case of chemistry, the minimum tensile test requirements for grades higher than X42 are subject to agreement. X46 and X52 are, however, commonly furnished to minimum yield strengths of 46,000 psi and 52,000 psi, respectively.

Weldability

The relativity of the term "weldability" is well known. For any given welding practice there will be a range of steel compositions which can be welded satisfactorily. When necessary to weld higher chemistry steels, modifications have been made in welding practices and a higher range of chemistries has been acceptable. In fact, virtually any steel may be considered weldable if the proper welding practices are employed. Admittedly some of these special practices are not suitable for field welding of pipelines. As mentioned earlier, API 5 LX specified certain maximum chemical requirements for the X-42 grade.

The yield strength requirements of high strength line pipe (X-46 and X-52) made by the expansion process can generally be met without exceeding the permissible X-42 limits. Expansion does not, however, increase the ultimate tensile strength as much as it does the yield strength. If high values of ultimate strength are required, they must be obtained from higher chemistries with some sacrifice in weldability. We have not observed too much field interest in ultimate strength requirements, no doubt due to the fact that most design factors are based primarily on yield strength.

So far as we have been able to determine, high strength line pipe which meets the API chemistry for X-42 can be welded satisfactorily with prevailing field welding practices. Where higher chemistries are required it may be necessary to modify the welding practices. General rules of thumb for weldable pipe chemistry are:

C plus Mn must be less than 1.50%

$$C + \frac{(Mn + Si)}{(\ 4\ )} \text{ must be less than } 0.55\%$$

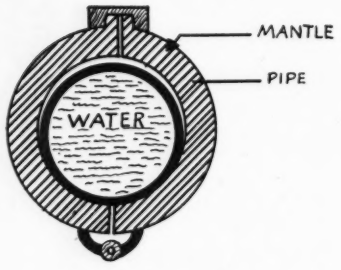

Fig. 7. Pipe section in expander.

Metallurgy of Welding

1. The weld bead is deposited in a molten state. Solidification of this metal occurs quite rapidly with dissipation of the heat to the body of the pipe.
2. The pipe wall adjacent to the weld will be heated to a temperature far above the transformation or heat treating temperature of the steel.
3. The rate of cooling of the weld metal and the "heat affected area" of the pipe will depend on the heat capacity of the pipe which in turn is related to the temperature and wall thickness of the pipe. High heat capacity means a rapid cooling or quench and goes along with low temperatures, no preheat, heavy walls, and high speed welding.
4. Two troubles may be encountered, either separately or together. The rapid cooling may produce cracks due to thermal shock and the rapid cooling may promote hardening of the pipe in the heat affected zone. In the event small cracks are produced by thermal shock and the pipe is hardened, the hardened structure is likely to be notch sensitive and the conditions are ideal for a service failure. Postheating tends to temper the pipe structure and make it less notch sensitive and thus to minimize the effect of any thermal cracks that may occur.
5. As mentioned earlier, high strength line pipe requires high chemistry, principally carbon and manganese. The susceptibility of the steel to cracking and to hardening is also increased by the higher chemistry. The effect of chemistry on hardening is rather well known and may be calculated from the presently available hardenability data. The effect of chemistry on susceptibility to thermal shock is not so well known quantitatively, but qualitatively higher chemistries tend to be more sensitive to thermal shock.
6. The subject of cooling rates would require far more time than we have here for a full discussion. Let it be assumed that the cooling rates in normal field welding are predictable within a reasonable range and see what the composition of the pipe has to do with the situation.

As a guide to weldability, the Grossman* method of calculating hardenablity from chemical composition may be useful. *Fig.* 6 shows a possible use of this method. Three lines are drawn on this diagram where the ordinate is per cent manganese and the abscissa is per cent carbon. These lines are drawn approximately through points of equivalent hardenability. The possible use of such a chart would be as follows:

Having established a satisfactory field welding practice for a given chemistry steel, for instance .30 carbon, 1.20 manganese, then any other composition of manganese and carbon along the line passing through this point would probably weld equally well, provided the same field welding conditions were maintained on the same size and wall pipe. Any composition below this line would be less likely to cause trouble, whereas any composition above the line might require changes in welding practice. The various areas of the diagram might be labeled as follows for field practices satisfactory to weld the .30 carbon, 1.20 Mn. grade:

I No particular problems.
II Requires reasonable attention to field practices as established.
III Requires considerable care and may require preheating or other precautions.
IV Probably will require a change in welding practice.

It should be emphasized that this diagram is not meant to be applied, except for one given set of field conditions, but it may be possible for field engineers to adapt this type of diagram for guidance under their particular welding conditions..

Cold Work—Expanded Pipe

It is a common experience that the strength of steel may be increased by cold work. Familiar examples are the cold rolling of steel sheet and the cold drawing of wire and bars. Similarly the strength of line pipe may be increased by cold work. The process for so doing seems somewhat more complicated because of the geometry of the pipe, but the net effect is the same. If a piece of line pipe is to be subjected to a presure above the yield strength pressure the pipe will expand permanently and the yield strength of the expanded pipe will be equivalent to the maximum pressure to which the pipe was subjected.

Practically, it is not possible to obtain much expansion and increase in strength unless the pipe is held in a closed cylinder or die so that the expansion may be uniform and under control. *Fig.* 7 shows a section of pipe in an expander ready for expansion. Usually about 1½% expan-

*Grossman, M. A. Hardenability calculated from Chemical Composition, Transactions AIME V. 150, 1942, pp. 227-259.

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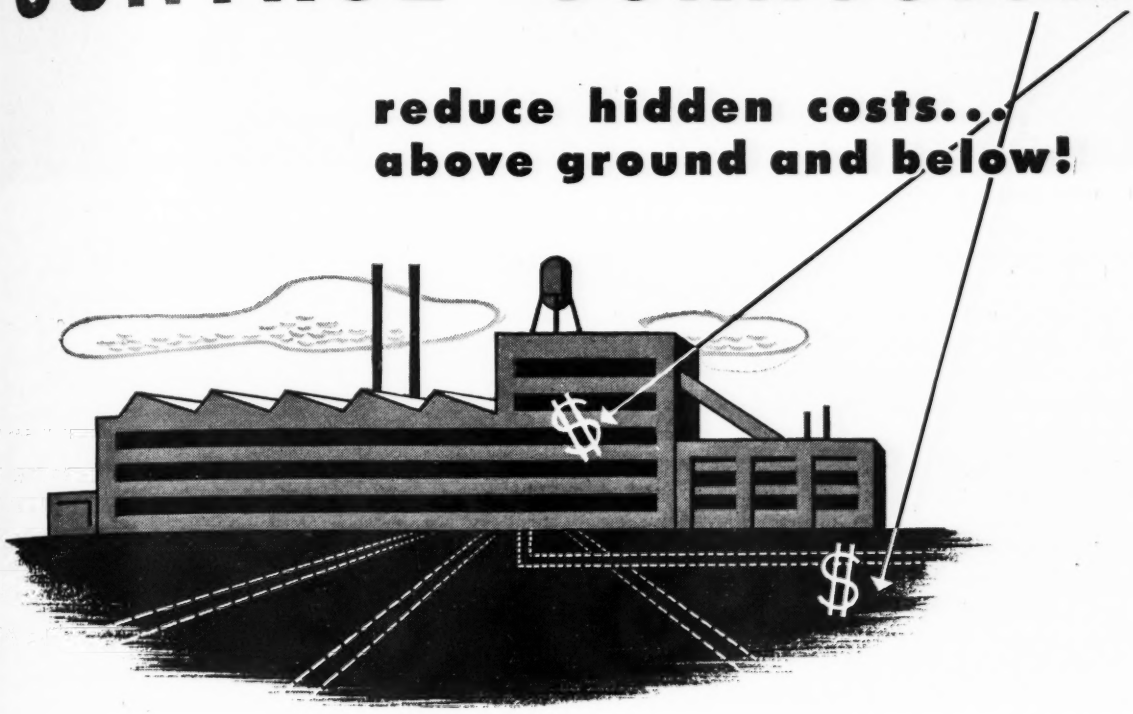

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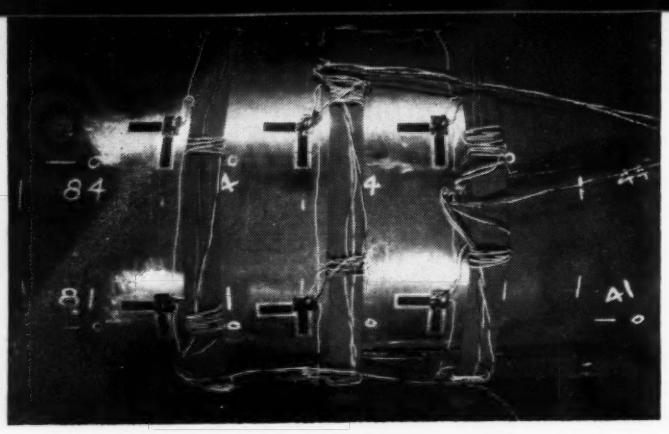


Fig. 8. Strain gauges in place on pipe.

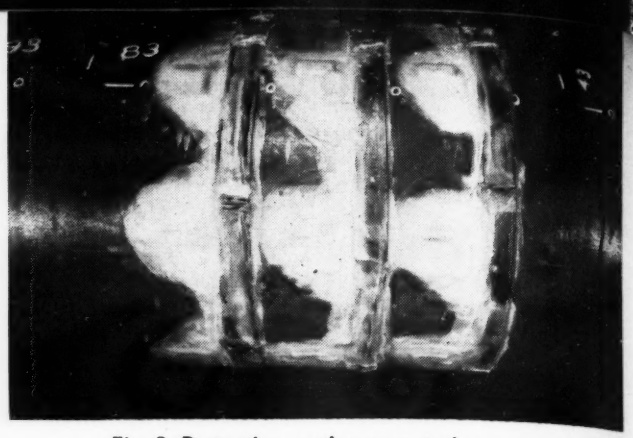


Fig. 9. Protective coating over strain gauges.

sion is considered a practical amount. It is thus possible to make X46 and X52 grades by expanding pipe of a chemical composition not much greater than the API limits for X42, the additional strength being gained from the cold work effect.

At the present time, cold expansion is principally used for the higher strength grades of welded pipe. At this point it should be noted that besides increasing the strength, hydrostatic expansion provides an excellent proof test of the weld. It is common practice to subject the pipe also to the usual API hydrostatic test after the expansion.

3. Service Stresses

Metal Fatigue

Failure of metal parts in service by fatigue is a common experience. Unfortunately, a clear picture of the mechanism of failure of metals in fatigue cannot be painted without getting somewhat involved technically. The usual explanation of fatigue is that the metal has "crystalized" because a coarse granular or crystaline structure is usually evident in the fractured sample. Metals do not "crystalize" in service, they are already crystalline before they are put in service, and most of their useful properties are due to their being crystalline in nature. Metals can fail in service when they are subjected to repeated stress, even though the maximum value of the stress is below their yield strength.

Such failures are known as fatigue failures. The fatigue strength of steel is frequently evaluated in the laboratory by means of the endurance test. The endurance limit or fatigue strength is defined as the greatest stress that can be applied to a steel an infinitely large number of times without causing failure. In laboratory testing, it is generally considered that 10 million applications of stress are sufficient to establish the fatigue strength.

Fatigue strength does not vary from heat to heat or lot to lot of steel of anywhere near the same composition. It is related to the tensile strength and, as a general rule in steels of the type used for line pipe, will be equal to about one-half the tensile strength. There is probably very little difference between the fatigue strength of pipe made by the different manufacturing processes.

If this were all there was to the problem of fatigue, design could be handled by adequate factors of safety, but unfortunately the fatigue resistance of any piece of steel is markedly affected by surface scratches, sharp corners, and notches. Any change in the surface or shape of a steel part which results in a concentration of stresses seriously reduces its fatigue strength.

It is difficult to imagine that fatigue is much of a factor to consider in the majority of conditions of service of pipelines. However, where a pipeline is subject to repeated vibrational stresses, such as in or near a pumping station or due to movement of pipe in a river crossing, it is probable that fatigue may be encountered.

After making every possible effort to

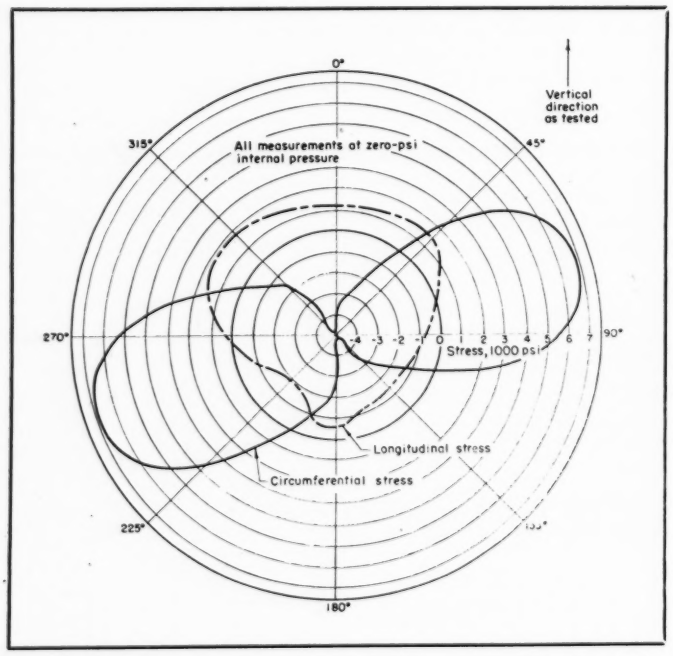


Fig. 10. Bending stresses in pipe resulting from weight of clay backfill.

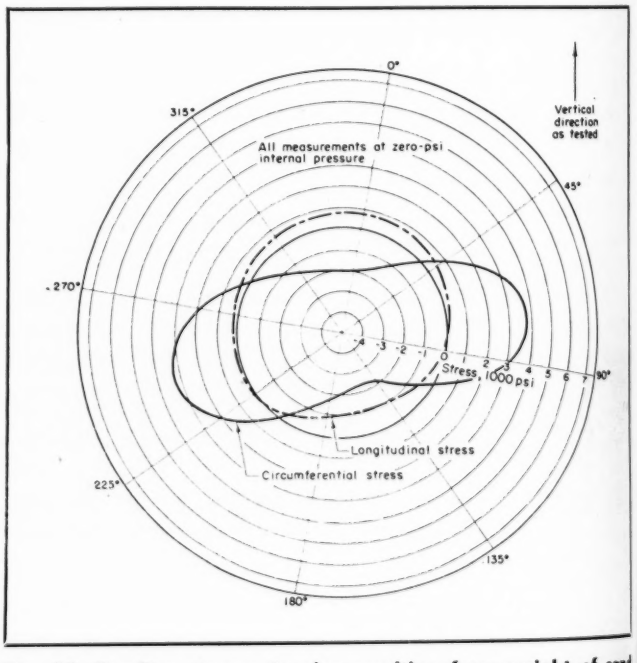
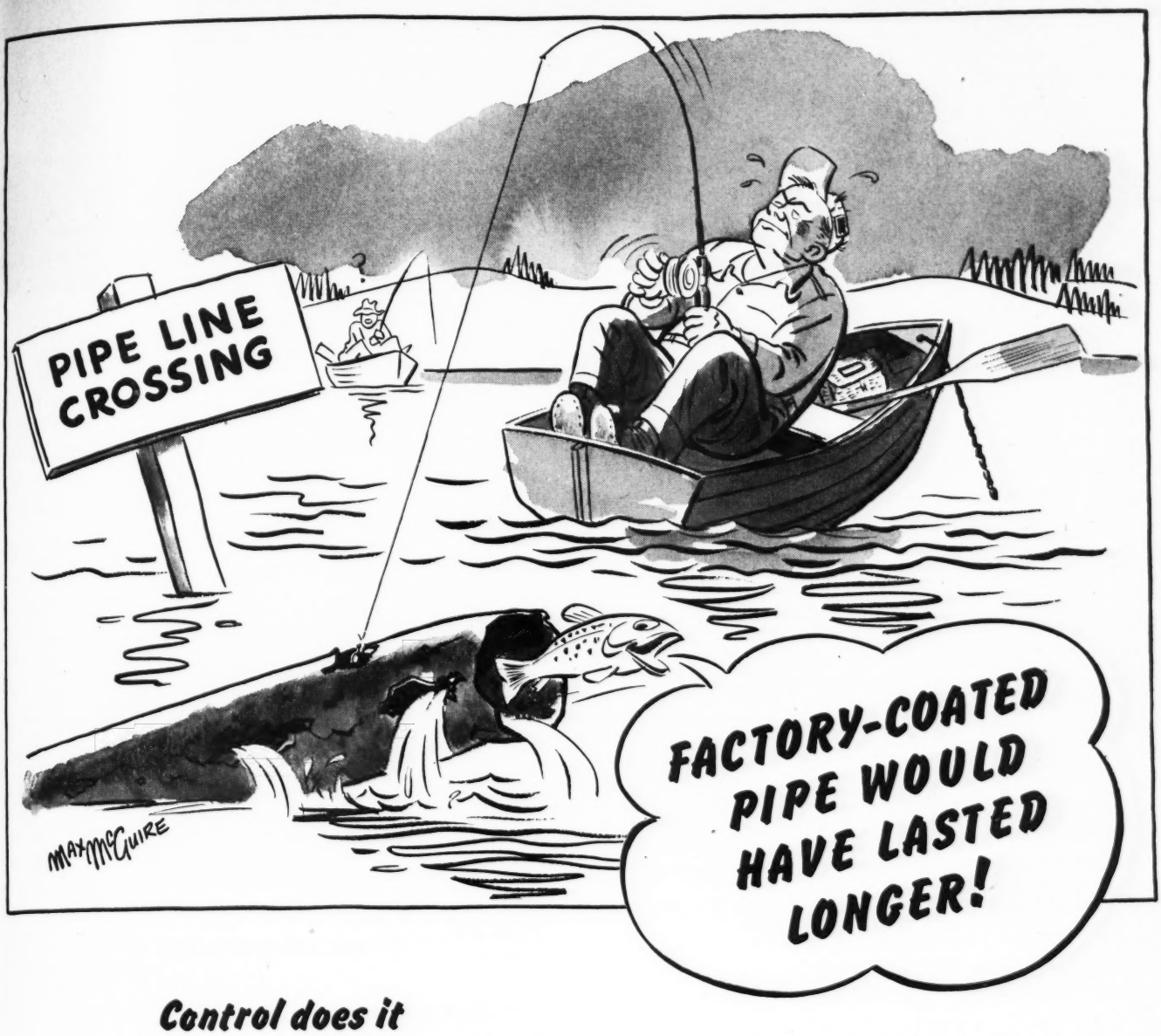


Fig. 11. Bending stresses in pipe resulting from weight of sand backfill.



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reduce or eliminate the vibration, it is also in order to allow extra factors of safety. In certain cases this still may not be enough and every possible scratch or gouge should be removed from the surface to minimize their effect in concentrating the stresses. If connections are made to a line in an area subject to vibration they should be welded with generous, large-radius filets.

The users of drill pipe have found that fatigue failures of drill pipe may be minimized by the avoidance of corrosive conditions and by the shot-peening of the surface of the pipe. Shot-peening is also used on crankshafts and certain other machine parts to minimize fatigue failures. Briefly, this process leaves the surface of the part with residual compressive stresses which in turn make fatigue failure less likely. Without more information than I presently have at hand, I could not guess that shot-peening of the surface of line pipe (including shot-peening of the girth welds) would be worth while in the prevention of fatigue. I am sure, however, that efforts to prevent corrosion of a pipeline subject to vibrational stresses would be worth while in minimizing failures.

Soil Stresses

For the past year we have been sponsoring a research study at Battelle Memorial Institute to learn something of the effect of soil pressure on the service stresses in large diameter line pipe.

This investigation was conducted to determine how stresses developed during proof testing of a pipeline may exceed those developed during the mill testing and how these stresses may vary from day to day and month to month after the pipeline is placed in service.

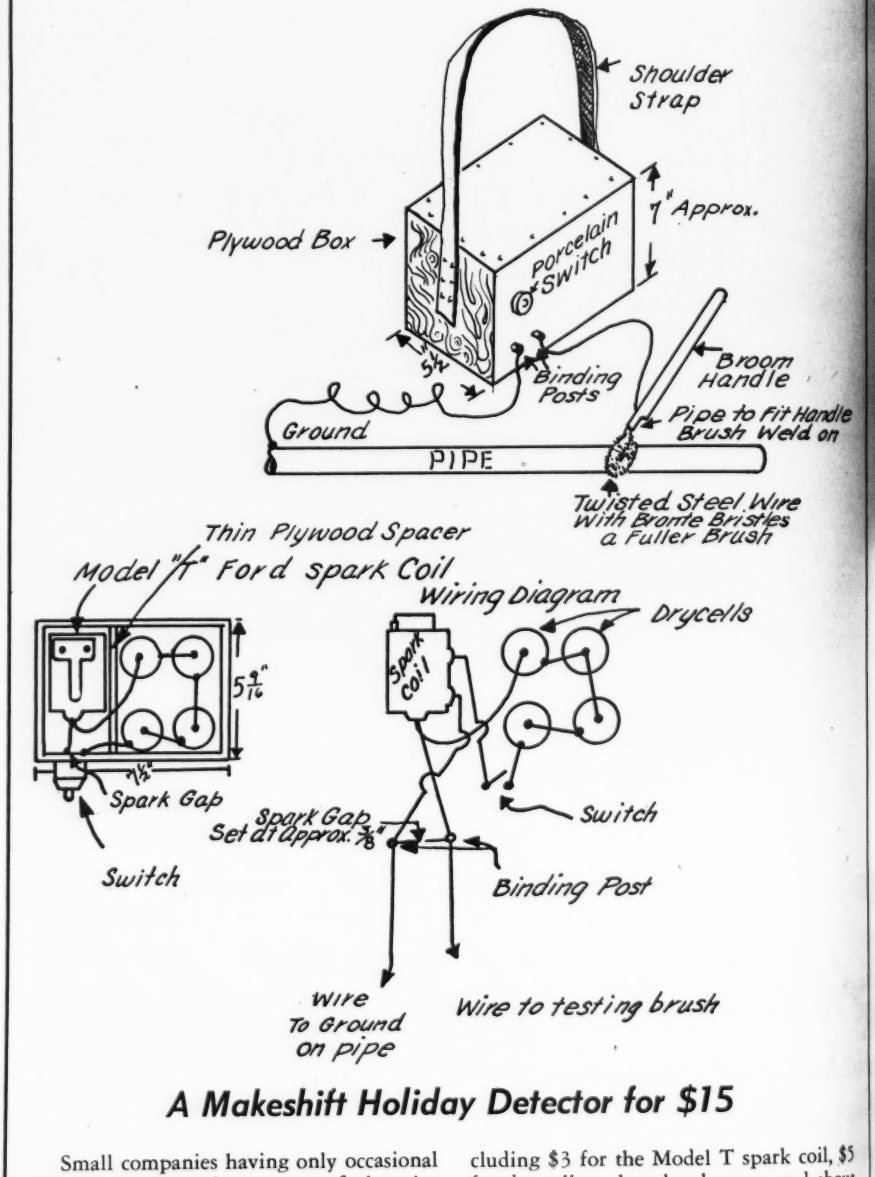
This investigation is being conducted on two lengths of 20-in. OD x .250-in. wall, grade X-46 electric weld line pipe, one of which was buried in sand and the other in clay-type soil. Both lengths of pipe were forced out-of-round prior to the test to make it possible to determine the bending stresses superimposed upon the circumferential stresses as an out-of-round pipe is pressured and to produce larger movements of the pipe wall against the soil. The stress measurements on the experimental pipe were obtained with SR-4 strain gauges located at specific positions on the pipe and properly insulated and protected to permit accurate reading when buried, as shown in *Fig. 8*. *Fig. 9* shows the protective coating over the gauges.

The results of this test program indicated that soil does not exert an appreciable "hold down" force on the pipe, but that it is uniform about the circumference; thus the only significant effect of the soil is to introduce bending moments in the pipe wall. These tests show that a plastic change in the shape of pipe, which may occur during transit or installation, will result in a substantial change in the stress system on subsequent pressuring in the ground. This explains why field failures may be encountered at pressures lower than mill-test pressures.

Fig. 10 shows the bending stresses in the pipe which is buried with a sand backfill. The nonuniformity of these stresses may be noted by the irregularity of the diagram. Similarly, *Fig. 11* shows the bending stresses in the pipe with a clay backfill. Additional study of these data indicate that the reinforcing effect of soil is better in sand than in clay.

On the basis of this test program, it has been suggested that possibly pipe should be proof tested after installation at a pressure in excess of 36 psi above the maximum service pressure, and since the conditions encountered during this study do not necessarily represent the most extreme conditions, Battelle recommends a margin of 150 psi internal pressure.

This article was presented at the Pipe Line Contractors Assn. meeting in Houston, Jan. 9. The discussion is based on API Standard 5LX, "Specification for High Test Line Pipe," which covers sizes from 6⅝-in. OD to 36-in. OD and wall thicknesses from 0.188-in. to 0.500-in. and recommends manufacturing processes.



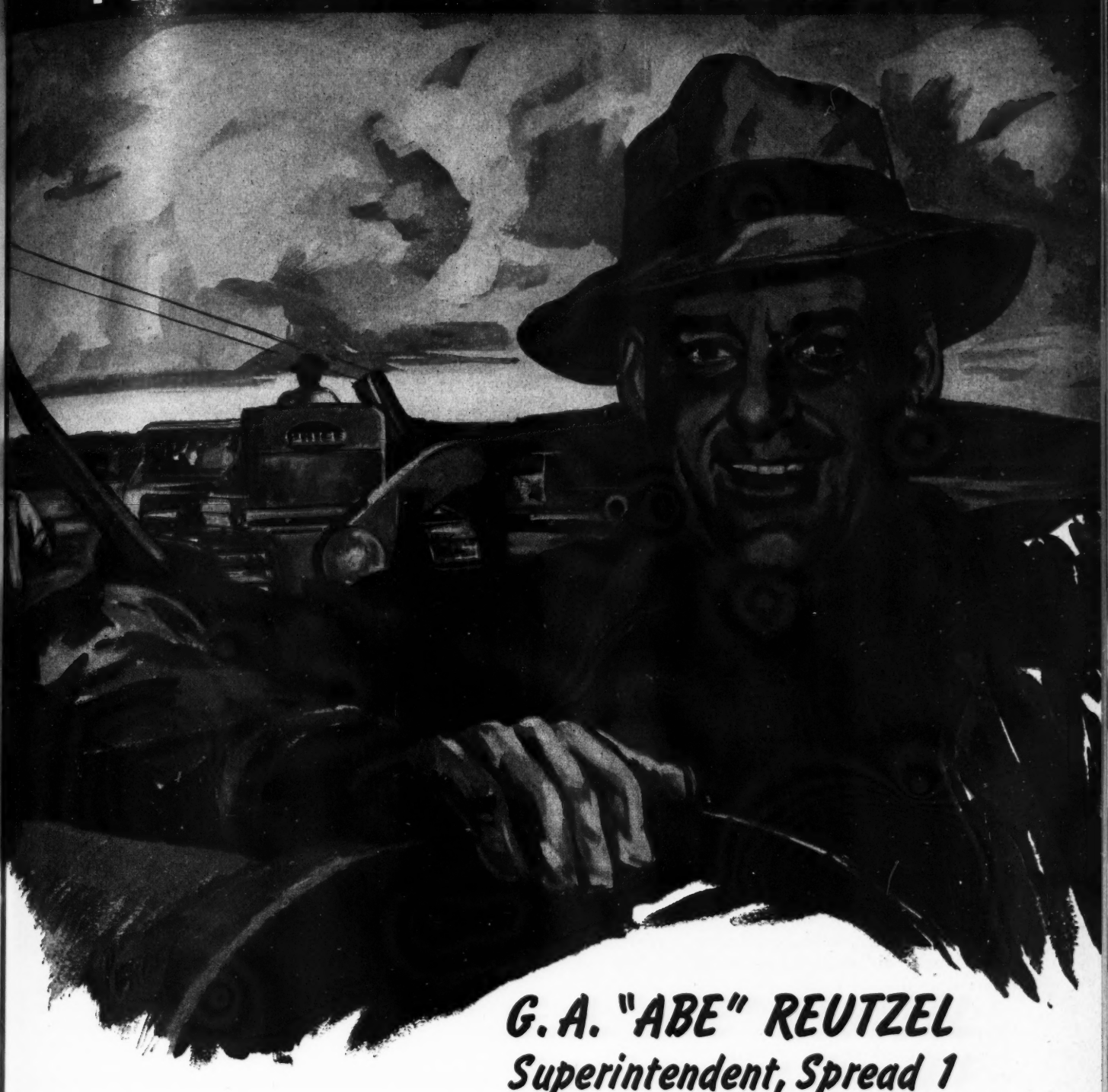
A Makeshift Holiday Detector for $15

Small companies having only occasional use for a holiday detector may find an inexpensive way to rig one up themselves in this makeshift device developed by Carl Greim of the Toledo Edison Co., Defiance, Ohio.

Total cost of the tester is about $15, including $3 for the Model T spark coil, $5 for dry cells or hot shot battery, and about $7 for the other materials required.

G. L. Wigglesworth, engineer for Citizens Gas Fuel Co., Adrian, Mich., which has copied the design, reports that "while it is crude, it gives good tests."

PRICE PIPELINE PORTRAITS



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Spanning Mississippi for Chicago Line Termed "Toughest Crossing"

(For more details on construction of the Texas Illinois line, see January GAS, p. 100.)

CONTRACTOR'S men who handled the job of traversing the Mississippi river with three 20-in. lines for Texas Illinois Natural Gas Pipe Line Co. last December say it was the toughest of all underwater river crossings in their experience.

Authorities for the assertion are M. T. Willhite and L. A. Davis of Midwestern Constructors Inc., Tulsa, who directed the task of spanning 3000 ft of unpredictable river, from Grand Tower, Ill., to Wittenberg, Mo. Nevertheless, the men did accomplish their objective: the line was ready to go Dec. 1, the target date.

One big obstacle was the weather. From the time the job got under way last June, abnormally high waters and heavy river currents had to be fought. Ice floating down the channel as winter approached was an even greater hazard.

In one instance, it appeared that the river had won a real victory over the men. On Nov. 18, as the pipe had been pulled out into a loop stretching two-thirds of the way across the river, the motion of a barge, pitching in the current, broke off the sealed end of the first of the three lines. So the line was moved a few feet upstream and a second line was put across, this time without mishap.

After the break was discovered in the first line, and the second had been put in service, the broken pipe-end had to be retrieved and the full length flushed with water to remove the sand.

Land work on both banks began June 1. The land line consists of 30-in. electric weld pipe, which joins the underwater lines on either bank. The 20-in. underwater lines are fabricated of 20-in. OD pipe with ½ in. wall, with two sheets of 5/16-in. plate rolled around the outside and welded. This extra wall thickness provides negative buoyancy of 38 lb per lineal foot, and the laminated construction of the lines eliminates the necessity of river clamps. Wood mats were wired about the lines for protection.

Forty-foot joints of pipe were welded together to form long sections on the bank. A railroad track was laid down the east bank, which slopes at a 26-deg. grade to the river, and on it were placed small cars which held the sections of pipe. The first section, 1500 ft long, was set in place on the cars and a watertight plug was welded to the leading end. Over the plug, a steel cap was welded, and through a hole in this cap a cable was passed from the cutter-head dredge, which lay at midstream, her spuds down solid in the river bed. About a mile of Jones & Laughlin ¼-in. wire cable, with a breaking strength of 69.45 tons, was used.

When the order to "heave 'round" came over two-way radio from the east bank to the dredge winch, the section was pulled half-way across the river. A guide made of war surplus airplane wheels steadied the pipe on the bank, and pontoon barges kept it afloat. A second section, 1000 ft in length, was welded to the first and pulled into the river, followed by a third, 500-ft section, completing the 3000-ft span.

The lines were laid in a trench, 20 to 40 ft in depth and 200 ft wide, which was carved by the cutter-head dredge and a sandsucker dredge.

Sections of 20-in. pipe await 3000-ft pull across Mississippi. The three lines connect with 30-in. main lines at Wittenberg, Mo. and Grand Tower, Ill.

On the Missouri bank, lines climb 45-deg. slope to connect through headers with 30-in. mainlines.

Where pipeline on bank lay across railroad tracks, dragline derrick, with help of side-boom tractors had to hoist pipe to let occasional trains pass underneath.

FLUOR air-cooled MUFFLERS

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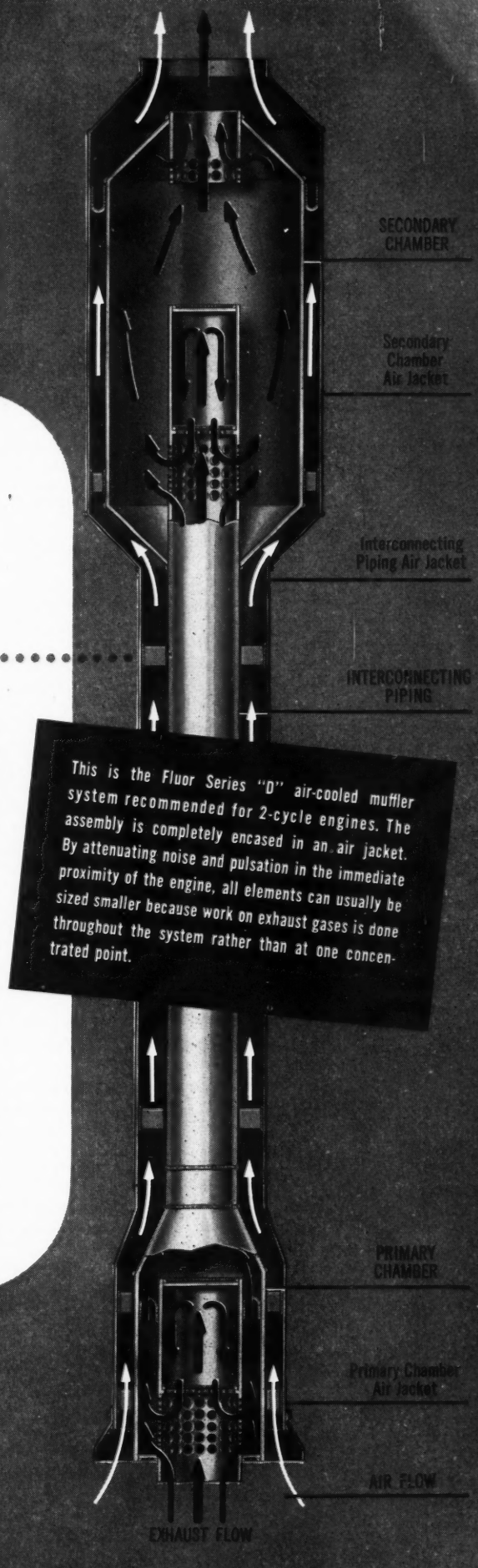

This is the Fluor Series "D" air-cooled muffler system recommended for 2-cycle engines. The assembly is completely encased in an air jacket. By attenuating noise and pulsation in the immediate proximity of the engine, all elements can usually be sized smaller because work on exhaust gases is done throughout the system rather than at one concentrated point.

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The air stream keeps the muffler chambers and interconnecting pipe cool, eliminates the need for exhaust-line insulation, ventilates the engine room and reduces spark hazard. Air cooling prolongs the life of mufflers by reducing corrosion due to heat. And, in many instances, water-cooled manifolds have been replaced with Fluor air-cooled muffler-manifold systems with excellent results.

Fluor Mufflers are available in the Series "D" (shown here), a dual-element system for 2-cycle engines, and in the Series "T", a single-element system for 4-cycle engines. Fluor Mufflers may be purchased with or without air-cooling features, with bottom or side inlets, and for engines in the 150 to 3500 H.P. class of virtually every make and model. For detailed information, write for Bulletin FM-8501.

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SINCE 1890

PIPELINE NEWS

April Hearings May Untangle Problems Surrounding Canadian Import and Export, Gas for Pacific Northwest

The interrelated problems of natural gas for and from Canada, with their many ramifications, just might possibly be moving toward a solution this month.

Involving a large handful of companies and several hundreds of millions of dollars, the several propositions to export gas from Alberta to the Pacific Northwest (and back into British Columbia), to pipe gas from Texas all the way to Seattle, to send gas east from Alberta into the eastern provinces, and to effect some horse trades at the border are due for further sifting. With optimists having declared that Alberta was to reach a decision on export permits by April 1, and with the FPC having definitely scheduled an omnibus hearing April 8, it has begun to appear that the hoary and perplexing export case might soon be resolved.

Similar predictions in the past have not, of course, panned out.

Pundits close to the Alberta picture declare that Alberta is now well satisfied that it has all the reserves needed to permit export, and it's only a matter of days until one of the companies gets the nod.

The FPC meanwhile is entertaining bids from Pacific Northwest Pipeline Corp., Northwest Natural, Westcoast Transmission, and Glacier Gas Co. for the franchise to serve the Northwest.

In the end, it may develop that the FPC (and/or the President) will hold the reins for both countries. Premier Manning is expected to say, "We have the gas available. Which company will carry it?"

Here are some of the more reecnt developments in the situation:

Pacific Northwest Pipeline Corp., a Ray Fish-backed company in Houston, readied its case for the FPC hearing by revising its entire scheme except for the reciprocal agreement for interchange of gas that was a central feature of the original idea. Under the new plan, Pacific Northwest would import, through a Canadian line to be built by its subsidiary, Prairie Transmission Lines, 250 MMcf per day. This would be taken at the International boundary at Stevens county Wash.; 25 MMcf would be returned to Prairie at the boundary adjacent to Whatcom county, Wash., for transmittal to Vancouver, B. C., and the remaining 225 would be brought to the Seattle, Spokane, Tacoma (Wash.) and Portland, Ore. areas.

A like amount of gas would be bought by Pacific Northwest from Panhandle Eastern Pipe Line Co., which is also backing the plan, at a point on the international line near River Rouge, Mich., for redelivery to Canadian Natural Gas Pipe Lines, Ltd., and distribution in Ontario and Quebec.

In its original application, filed June 29, 1950, Pacific Northwest had sought permission to build a 2175-mile line from Texas, linking near the Washington-Canada border with a Prairie line from Alberta, to serve the Pacific Northwest area. The new plan represents a reduction from $175 million to $58.5 million in estimated costs, and covers a 653-mile mainline, 175 miles of spurs and laterals, and 14,080 hp in three compressor stations.

Northwest Natural and Westcoast Transmission still retain, in essence, their original plans to pipe gas directly from Alberta to the Northwest for distribution in Washington, Oregon and British Columbia. Glacier Gas, a Montana Power Co. (Butte) subsidiary, would buy gas at the border from Westcoast and distribute it in Montana, Idaho, and eastern Washington.

The Pacific Northwest plan was obviously wrought to provide an answer to those who insist that Canada's needs be provided first before export outside the country is permitted. Proponents of this argument find their champion in Trans-Canada Pipe Lines Ltd., Calgary, whose plan for a $253 million line running east from Princess, Alberta, to Ottawa and Montreal, is pending before the provincial conservation board.

Although Trans-Canada is set up as an all-Canada line, civic leaders in the Michigan peninsula and the "iron range" of Minnesota and Wisconsin are further confusing the state of things by pressuring Trans-Canada to change its route, cutting southeast from Winnipeg, Man., through Duluth, Minn., and across the U. S. just south of Lake Superior, and finally recrossing into Canada at Saulte St. Marie.

Meanwhile, those who are still hopeful that Alberta gas will wind up in Washington and Oregon see some promise in the tremendous drilling activity now going on in Saskkatchewan, which might help to take the pressure off Alberta when it comes to serving the needs of eastern Canada.

Not quite forgotten in the turmoil is Trans-Northwest Gas Inc., of Spokane, whose case has been presented to the Idaho Public Utilities Commission. Trans-Northwest would lay lines across the state, acting as a sort of middleman. Not only has Trans-Northwest incurred the ire of the principals in the import battle, but it has also been the target for the Brotherhood of Railway Trainmen, United Mine Workers, and other coal interests which fear a heavy displacement of their fuel by natural gas. These same groups are also planning to descend on Washington (D. C.) this month for the FPC hearings.

Examiner Would Authorize Rockville Storage Plant

FPC Presiding Examiner Samuel W. Jensch has filed a decision which would authorize Washington (D. C.) Gas Light Co. to build and operate a standby gas storage plant near Rockville, Md.

According to the initial decision, however, the company would be required to employ the facilities whenever they can be useful, including peak shaving to reduce the cost of gas purchased from Atlantic Seaboard Corp., its supplier. Washington Gas Light had proposed to use the plant as a standby facility to provide gas only if a break occurred in the supplier's line.

Last Aug. 9 the commission granted temporary authorization for the company to begin building the $6,820,000 plant, subject to the condition that, if necessary, the facilities be used to reduce the cost of gas from Seaboard. Underground steel pipe would provide storage capacity of 625,000 gals. of propane which, when gasified, would have a daily capacity of 30 MMcf of natural gas. Total delivery capacity of the plant is 7 MMcf per hour for a 14- or 15-hr period.

Commenting on the company's proposal to use the plant only in the event of a break on Seaboard's line, the examiner pointed out that there have been only six such failures during the last 20 years. In addition, Washington Gas Light may sometime expand the Rockville facilities, doubling capacity and bringing total plant investment to $15 million. In view of such an expenditure, it would be unreasonable to leave the facilities idle, the examiner said.

Battle Still Wages Over New England Markets

An appeal for further hearing before the FPC of the commission's order dividing transmission of natural gas to New England between two companies was taken under advisement last month by the U. S. Circuit Court of Appeals in Philadelphia.

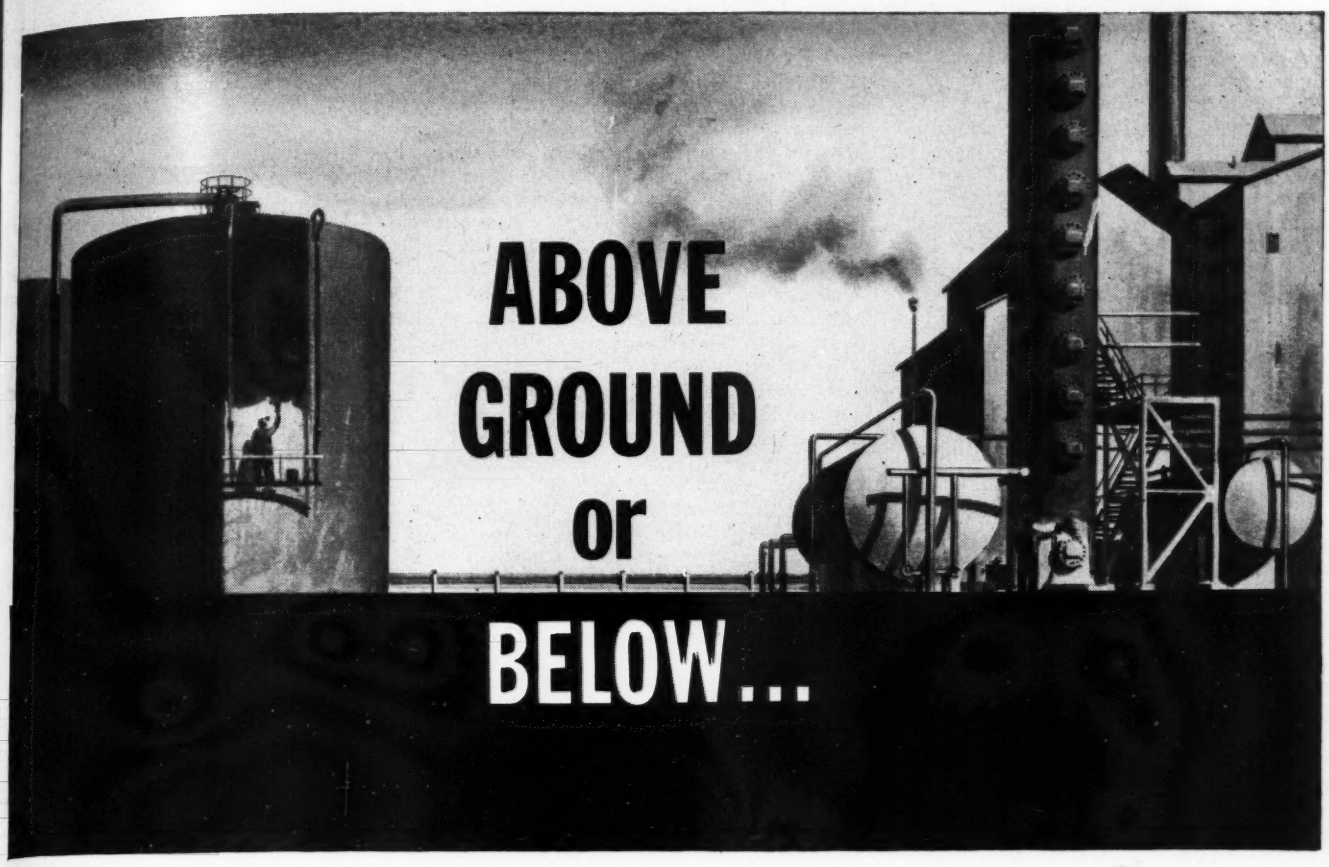
Northeastern Gas Transmission Co. contested an FPC permit which allowed it and Algonquin Gas Transmission Co. to serve New England, contending that the commission erred in dismissing Northeastern's application to serve the area with a single system. The company claimed that FPC dismissed the competitive and major portion of its application without a hearing and that it had been "denied due process of law."

Bradford Ross, general FPC counsel, told the court that both companies had placed their own selfish interests above the best interest of the public. He added that neither firm had proved that it alone could provide adequate service to New England at reasonable cost. Algonquin's attorney stated that there was "substantial evidence to support the commission's finding."

Meanwhile, right-of-way battles were still delaying both companies. In Connecticut, the state supreme court cleared the way for a superior court hearing in Bridgeport on motions of Northeastern for immediate possession of Fairfield county properties.

Transcontinental Gas Pipe Line Corp. expressed its desire to drop a suit to restrain the town of Rye, N. Y. from enforcing its zoning ordinance against the building of a natural gas compressor station. An FPC hearing was scheduled for March 24 to determine whether Transco would be relieved of obligations to deliver gas to Northeastern in New England.

"We want to abandon the delivery of this gas to New England and the building of the compressor station and will act accordingly if the FPC gives us permission," Robert S. Bruns, Transco vice president, said. "We will eventually run a line through Westchester county to serve New England and give us another entrance into New York



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City, but this line would not require a compressor station at Rye," he added.

A proposed 3.5-mile right-of-way through Hanover (N.J.) township, sought by Algonquin for its 26-in. mainline, was approved by a township committee. As now planned, the line will bypass the site of a proposed $300,000 school.

TGT Hearing Scheduled; Applications Consolidated

Applications relating to the Tennessee Gas Transmission Co. proposal to expand its pipeline system were scheduled for a consolidated FPC hearing April 1.

The applications were made by East Tennessee Natural Gas Co., Chattanooga; United Natural Gas Co., Oil City, Pa.; Manufacturers Light & Heat Co., Pittsburgh; United Fuel Gas Co., Charleston; Republic Light, Heat & Power Co. Inc., Buffalo; and the City of Clarksville, Tenn. All of the companies, as well as Clarksville, are to be supplied with gas via the new lines.

Tennessee's project is similar to one for which it refused to accept an FPC certificate last summer. The construction plans, with an estimated cost of $128,216,000, provide for 591 miles of parallel loop along the existing system; 304 miles of 24-in. line from Mercer, Pa., area to Utica, N. Y.; 137,000 hp in existing or authorized compressor stations; 28,000 hp in new stations; and 250 miles of miscellaneous lateral lines.

The new facilities would increase Tennessee's delivery capacity from 1.3 billion cu ft of natural gas per day to a new total of 1.5 billion.

The applications made by United Fuel and Manufacturers relate to Tennessee's proposal to deliver 25 MMcf daily directly to Manufacturers, in its northern rate zone, after completion of the new facilities. Delivery is now made to United Fuel, in the eastern rate zone, for the account of Manufacturers. A 60-day temporary certificate was granted Feb. 15 authorizing the transfer of delivery.

The application made by East Tennessee proposed construction of a 100-mile, 16-in. line from Knoxville to Kingsport, plus other necessary facilities, a project to cost $5.2 million, for the additional 40 MMcf/d Tennessee is to supply them.

The City of Clarksville asks to be supplied with gas and Republic Light Heat & Power Co. seeks an additional 1 MMcf daily. United Natural, Equitable Gas Co., and Iroquois Gas Corp. each want an additional 15 MMcf daily, and 65 MMcf/d is sought by Northeastern Gas Transmission Co.

In addition, Tennessee and United Natural plan to construct jointly, at a cost of $7.4 million, a storage plant in Potter county, Pa., which would provide an additional 200 MMcf peak day delivery capacity.

U. S. Gas Companies Bid For Mexican Natural Gas

Negotiations with the Mexican government for purchase of existing natural gas supplies in northern Mexico and permission to drill additional wells reportedly are underway by half a dozen American gas companies.

Discussions opened in February between Phillips Petroleum Co., Bartlesville, Okla., represented by Edwin Pauley, Los Angeles oilman, and Pemex, the government oil administration. Mr. Pauley's organization has proved a large gas field near Reynosa, near the Texas border.

Sinclair interests, through Sintex, their Mexican affiliate, have also been eyeing the Reynosa gas. It is believed that Sinclair would sell the gas to Tennessee Gas Transmission Co., whose mainline in Texas is only some seven miles from the Mexican field.

At least four other major U. S. firms are bidding for Mexican gas or planning to do so, according to Manuel Morris, INS correspondent in Mexico City. Meanwhile, the Mexican government is building a $1 million line, scheduled for completion this year, from the Reynosa area southwest to Monterrey.

Cooper-Bessemer Opens New Orleans Headquarters

Cooper-Bessemer Corp., Mount Vernon, Ohio, recently established a combined regional office and warehouse at New Orleans to provide direct factory representation for all engineering service requirements on engine and compressor applications. In addition, the warehouse will stock essential parts for servicing marine and industrial installations in the southern gulf coast area.

Directing the New Orleans operation are T. E. Kraner, branch manager, and F. A. Gehres, assistant branch manager. Mr. Kraner has been associated with the firm since 1937. In the Washington office he worked on applications involving diesel power for naval and maritime vessels and, in 1946, he was assigned to the company's Caracas, Venezuela office as branch manager.

T. E. Kraner

F. A. Gehres

The Houston office of Cooper-Bessemer has been Mr. Gehres' headquarters for most of his service with the firm, which began in 1939.

Southern Natural Plans $76 Million Expansion

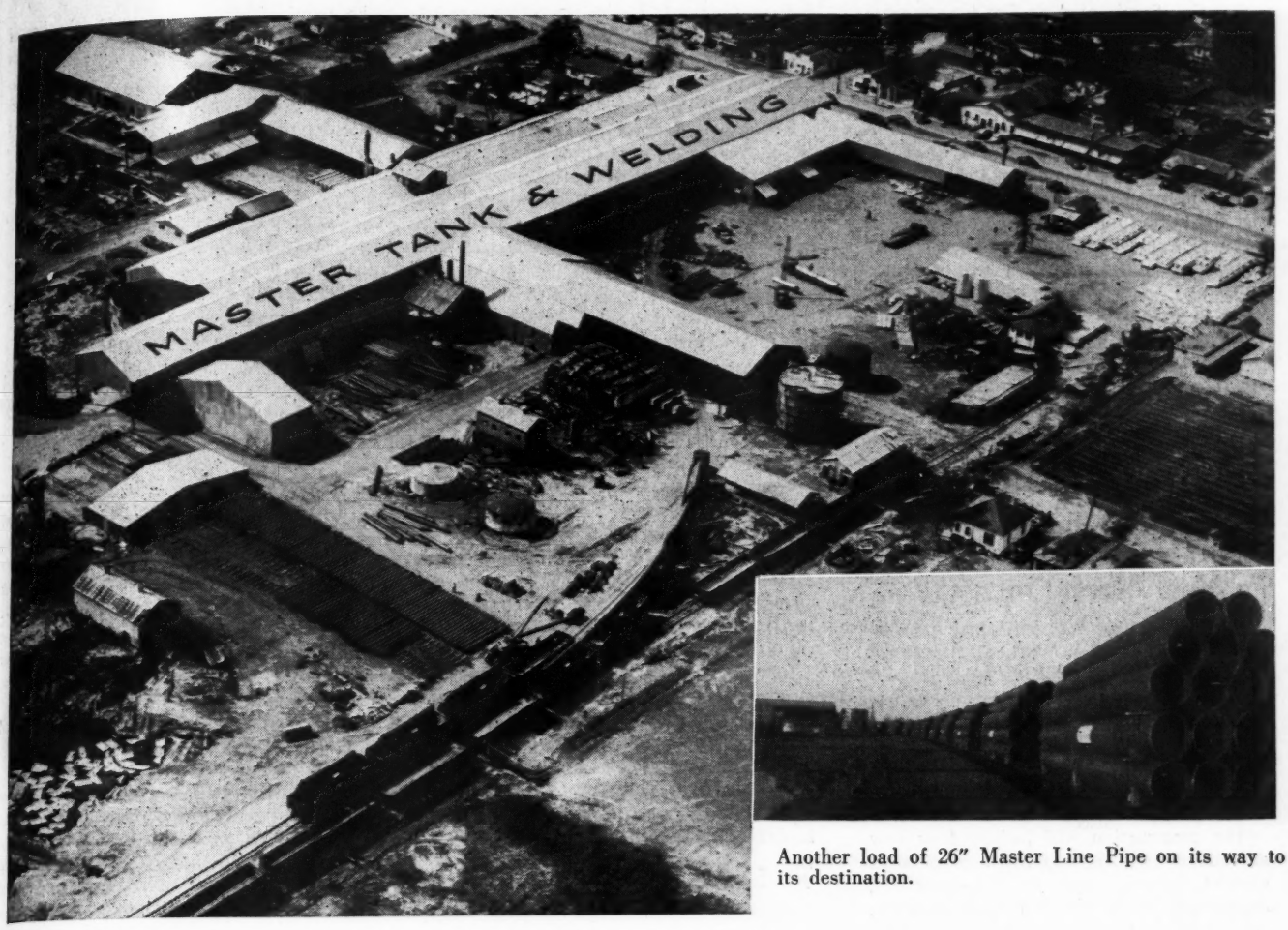
Southern Natural Gas Co. has applied for FPC approval of a $76 million expansion program to extend pipelines to more than 50 communities in Mississippi, Alabama, Georgia, and Florida.

The project includes the addition of 1254 miles of pipeline and 22,250 in compressor hp to an existing line from Texas to Georgia and a new gas supply system with 410 miles of pipeline and 3300 compressor hp to bring gas to the Gwinville field in Mississippi from the Sandy Hook field (Miss.) and from south Louisiana fields.

According to plan, 561 miles of line and 16,550 hp and other facilities would be added to the system northeast of the Gwinville field; and a new 2400-hp station is to be built at Gass Junction, Ga., with a 110-mile, 16-in. pipeline extension to Georgia and a 20-mile extension to Aiken, S. C. A 120-mile lateral line would extend from the Macon-Augusta line to Savannah.

The new facilities, scheduled for completion in 1954, would be used to supply the Southeast Alabama Gas District; South Georgia Natural Gas Co. Inc.; Atlanta Gas Light Co., Augusta; South Carolina Electric

Turning the valve which brought the first natural gas to Coldwater, Mich. recently are H. A. Sebald, vice president and general manager of Michigan Gas Utilities Co., and Fred Weeks, mayor of Coldwater. Onlookers are (from left) Charles F. Clarke, local manager of the company; L. W. Case, engineer; and William E. Scorah, Michigan Gas Utilities president. The firm built a 66-mile line from Panhandle Eastern's line at Marshall, Mich. to carry gas to Coldwater, Hillsdale, and Sturgis.



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& Gas Co.; South Atlantic Gas Co., Savannah; and Georgia Power Co.

South Georgia recently signed a contract with Southern Natural for gas to supply 14 Georgia and Florida towns.

Completion of the three-year construction program would increase the capacity of Southern Natural's system by 350 MMcf a day, bringing the total daily system capacity over the billion mark.

A major part of the additional gas supply would come from 13 gas fields in south Louisiana. Many of the fields are under water in the Mississippi River Delta area south of New Orleans.

Completion of the proposed construction would extend Southern Natural's system from Texas to the east coast. At present the system extends to central Georgia, but plans already approved call for construction of a line to Augusta and Aiken, S. C.

New York State Expands To Meet Market Increase

To meet the normal development of its present markets, New York State Natural Gas Corp., New York City, plans to add 104.7 miles of transmission lines to its system and to install 1820 additional hp at two compressor stations. The Federal Power Commission has authorized the construction, a project with an estimated cost of $6,018,900.

The construction will include four new sections of 14-, 16-, and 20-in. pipeline to parallel existing lines in Westmoreland, Armstrong, Tioga, and Potter counties, Pa., and in Wyoming, Onondaga, and Cayuga counties, N. Y. A fifth section will replace an existing line. The additional compressor horsepower will be at stations in Westmoreland and Tioga counties. Construction will be financed through the company's sale of securities to its parent, Consolidated Natural Gas Co.

The new facilities will enable New York State Natural to meet the expected demand increase of its present markets, particularly those in Syracuse, Rochester, Utica, Albany, and Buffalo, as well as those served by its affiliates, East Ohio Gas Co. and Peoples Natural Gas Co.

New York State Natural's present system is sufficient to meet the demand on the peak day this winter, an estimated 708 MMcf of gas, and the facilities planned, including those previously authorized, should enable the company to meet a 1953-54 peak day demand of about 909 MMcf. The facilities authorized in FPC's recent action are expected to increase the company's delivery capacity by 100 MMcf per day.

San Juan Basin Reserves Sold to El Paso Natural

Sale of gas interests in 80,000 acres in the San Juan basin of northwestern New Mexico to El Paso Natural Gas Co. has been completed. General American Oil Co. received $1.3 million for the properties and retains a quarter interest in the lease free of development costs but subject to proration of operating expense.

El Paso Natural is beginning an active drilling program. Under the terms, any oil discovered will be sold to General American. That firm, in turn, will continue oil explorations in the area but will sell any gas wells it finds to El Paso.

Meanwhile, Utah Pipe Line Co., Dallas, has withdrawn its application to the Federal Power Commission in which it sought to build a New Mexico-to-Utah natural gas line. The $22 million project was dependent upon the San Juan basin gas supplies sold to El Paso.

Mississippi River Fuel Application Dismissed

Mississippi River Fuel Corp.'s request for permission to add facilities has been dismissed without prejudice by the Federal Power Commission.

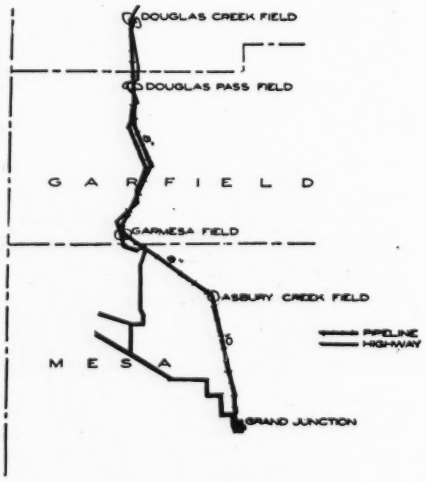
The St. Louis utility had advised the commission that it could not furnish supplemental information as required and now plans to file a new or amended application changing the proposed project entirely. Consequently, the company did not object to the dismissal of the pending application.

The project originally proposed was construction of a 5500-hp compressor station and additional units totaling 22,000 hp in eight previously authorized stations in Arkansas and Missouri.

Denver Utility's Subsidiary To Serve Grand Junction

Western Slope Gas Co., a newly incorporated wholly owned subsidiary of Public Service Co. of Colorado, Denver, plans to build and operate a pipeline to take natural gas to Grand Junction, Colo. from the Douglas Creek, Garmesa, Highline Canal, Asbury Creek, and Twin Buttes fields, all in Colorado. Reserve estimates by companies operating in these fields have convinced the Denver company that there is enough gas to supply the Grand Junction market for at least 20 years.

If PAD approves, Public Service will turn over to Western Slope Gas 16 miles of 10-in. line originally purchased to take gas to Grand Junction from the Piceance field. About 49 miles of additional mainline will be required, as well as some 30 miles of gathering lines and the city distribution system.



Proposed route of Western Slope Gas Co. line.

Some 18 months ago, Grand Valley Pipeline Co., of which Public Service Co. of Colorado owned one-third, made plans to serve Grand Junction and Rifle from Piceance. Its project was shelved indefinitely when General Petroleum Co. cancelled its gas supply contract with the firm.

Pipeliners Attend Tulsa NACE Corrosion School

Some 200 pipeliners received simplified instruction on practical control of pipeline corrosion at the Feb. 27-29 school held by the Tulsa section of the National Assn. of Corrosion Engineers.

Planning and conducting the third annual school was a general committee composed of J. R. Cowles, Oklahoma Natural Gas Co., chairman; F. M. Cloninger, Texas Pipe Line Co.; O. E. Murrey, Midwestern Engine & Equipment Co.; H. M. Hughes, Oklahoma Natural; Sam E. Bosley, Owens-Corning Fiberglas Corp.; Hugh A. Brady, Pipeline Maintenance Corp. and Y. W. Titterington, Standard Magnesium Corp.

Instruction and field work were conducted by Mr. Cowles and W. E. Huddleston, Huddleston Engineering Co.

In introductory sessions, the theory of underground corrosion was explained as an electrical phenomenon. It was shown that cathodic protection, by the simplest theory, is merely a matter of increasing a natural bottleneck of corrosion, i.e., the hydrogen film on the cathode, until the cathodic areas have the same voltage as the anodic (pitting) areas. Amperes, volts, and ohms were explained by analogy with gas.

Flow of current to and from electrodes was demonstrated, as were anode installations and behavior, holiday detectors, insulating joints, and coatings. Soils, soil resistivity and means of measuring it, and rectifiers were discussed.

Cost data on cathodic protection were presented, using such rough rules as $15 per anode worth 100 milliamperes per 10 years and one milliampere per sq ft of pipe (or 1 ft of 4-in. equivalent pipe), usually found sufficient to reduce corrosion to a tolerable amount on bare pipe in Oklahoma. The economy of coated pipe with insulation such as flanges was covered, and rectifiers and their cost were discussed.

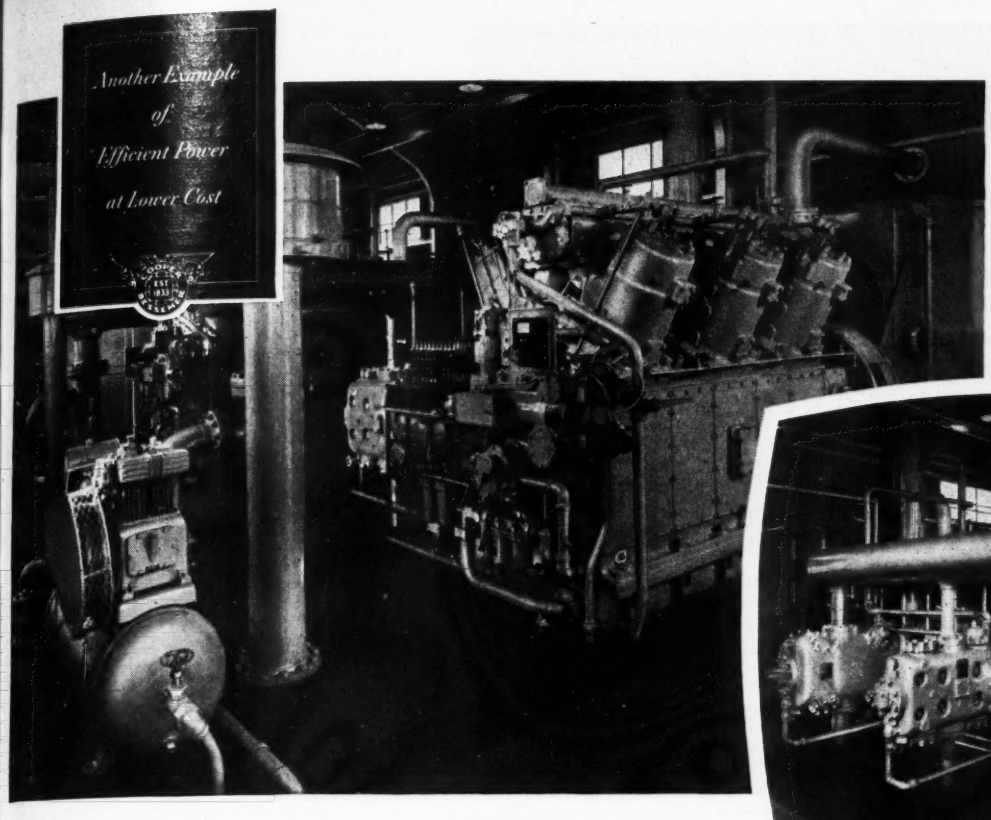
Inspection trips to Tulsa Pipe Coating Co., Standard Magnesium Corp., and Allied Paint Co. terminated the sessions.

United Gets Louisiana Gas

United Gas Pipe Line Co., Shreveport, has secured gas purchase contracts from Shell Oil Co., covering reserves in its Turtle Bayou field, and from Union Producing Co. for its reserves in the Kent Bayou field, both in Louisiana.

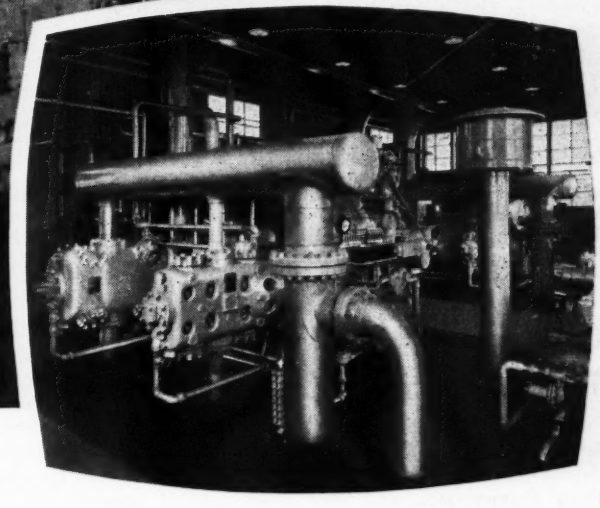
United will construct a $1,461,000 pipeline to the fields. There is no outlet for the gas at present. The proposed 11.3-mile 20-in. line will connect with United's system in Terrebonne parish, La.

The Federal Power Commission has approved the plans.



Left: Two Cooper-Bessemer skid-mounted GMX-6 compressors in Lone Star's Abilene Booster Station. Station is piped for either east or west delivery. Units are equipped to provide proper unloading to permit broad flexibility in meeting pressure conditions.

Below: Compressor cylinder side of above skid-mounted units. Floor line is flush with tops of skids resulting in conventional floor appearance and simplicity.



GMX's at Lone Star's Abilene Booster Station

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IT MIGHT surprise you to know that the GMX's pictured opposite are skid-mounted units . . . 2 packages, factory tested and delivered complete with all auxiliary equipment. It's quite an advantage —made possible by the simplicity and extreme compactness of these modern Cooper-Bessemer compressors.

Secondly, and perhaps even more remarkable, is the unusual flexibility of this compressor set-up. The station is piped so that it can pump either east or west —necessitating compressors that would operate efficiently despite widely varying pressure conditions. These GMX's readily provided with the proper unloading facilities to permit such flexibility. And, with suction pressures running lower than anticipated, months on end, it's another example of how well GMX's can handle tough jobs.

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W. E. Huddleston (right), consulting engineer, demonstrates road-casing test to T. D. Williamson Inc. representatives attending NACE Tulsa corrosion school. Agents of the Tulsa firm, gathering from all over the country, included (from left) Norman Williams, Floyd Zongker, Linden Stuart Jr., T. D. Williamson, Harold Davis, James Kone, Dale Hardy, and T. D. Williamson Jr.

Columbia Subsidiaries Ask To Build Facilities

In a new application, three Columbia Gas System subsidiaries have requested FPC authority to build about 94 miles of line in Ohio, Pennsylvania, and New York. The construction would improve deliverability of their systems to help assure continued service to present customers and provide for normal growth, the applicants said.

Manufacturers Light & Heat Co. would build 40 miles of line in Pennsylvania and Ohio, and retire 34 miles of line in Allegheny, Washington, and Clarion counties, Pa., and Belmont and Columbiana counties, Ohio, as well as a compressor station in Lawrence county, Pa., and a compressor unit in Columbiana county, Ohio.

Natural Gas Co. of West Virginia wants permission to construct 21 miles of line in Columbiana and Stark counties, Ohio, and to retire two compressor units in Belmont county. Home Gas Co. would build 32.5 miles of line in Chemung and Broome counties, New York.

The three firms are located in Pittsburgh. Cost is estimated at $3,829,677: $2,111,077 for Manufacturers, $618,600 for Natural, and $1.1 million for Home.

FPC Examiner Recommends Texas Eastern Allocation

Twenty corporations and towns would receive 28,081 Mcf of gas per day from the system of Texas Eastern Transmission Corp., Shreveport, under the terms of a decision filed last month by FPC Presiding Examiner Marvin Farrington.

The gas is to be the previously unallocated and unsold capacity which the company estimates will be available upon completion of its authorized expansion program, including the Oakford (Pa.) storage project which is being developed jointly with New York State Natural Gas Corp. Remaining volumes, in excess of the 28,081 Mcf, are to be devoted to storage area development, according to the decision.

In addition, upon completion of the storage field, Texas Eastern must file an application with the commission proposing disposition of the maximum delivery capacity of its system by specific volumes to specific customers.

Thirty-eight applications or petitions were filed in the proceedings by companies and municipalities which were seeking a total of 161,251 Mcf from the company.

Transmission Safety Group Holds Shreveport Meeting

In mid-March, 23 safety representatives from 11 major natural gas transmission companies gathered in Shreveport for a two-day meeting of the Natural Gas Transmission Safety Assn.

T. J. O'Donnell, El Paso Natural Gas Co., is serving as chairman of the organization, which was founded about a year ago. Two previous meetings have been held — in Wichita and Amarillo — and plans call for two meetings a year in the future.

Featured at the Shreveport confab was a roundtable discussion of the various accidents suffered by employees of the companies represented, with special emphasis on vehicular mishaps. Another highlight was the presentation of a monthly accident prevention report prepared under the supervision of Stanley Owens, director of safety, Transcontinental Gas Pipe Line Corp., Houston.

A film on "Fighting of High Pressure Gas Fires" was viewed at one session.

Kentucky Line Proposed

Central Kentucky Natural Gas Co., Charleston, is seeking FPC authorization for construction of an 8.8-mile, 20-in. pipeline in Kentucky to increase its service to the Cincinnati market.

The proposed line, estimated to cost $676,000, would parallel an existing line serving Union Light Heat & Power Co., Covington, Ky., and Cincinnati Gas & Electric Co., and would enable Central Kentucky to increase its deliveries to the Cincinnati area by 85 MMcf per day. The capacity of the existing line to that area is 297 MMcf daily.

Ohio Fuel Requests Line To Increase Gas Storage

Storage area for a greater volume of gas will be available to Ohio Fuel Gas Co., Columbus, after construction of a 31.2-mile pipeline recently authorized by the Federal Power Commission.

The proposed 20-in. line, to cost an estimated $1,440,000, will extend from the company's Treat compressor station in Licking county, Ohio, to its Weaver storage compressor in Richland county, Ohio.

The new facilities will permit storage of more gas in the northern part of the company's system, where lack of gas from outside sources makes it necessary to meet peak loads from storage areas.

Ohio Fuel's present capacity for transporting gas north of the Treat station is estimated at 195 MMcf per day and Ohio Fuel estimates that during July of 1952 an average of 260 MMcf per day will be required for placement into the northern Ohio storage areas. The new facilities are expected to have a capacity of 142 MMcf daily.

Consolidated FPC Hearing Postponed Indefinitely

A consolidated FPC hearing to consider applications involving expansion plans of four companies and scheduled for March 4 has been postponed indefinitely. The applications relate to proposed pipeline facilities to serve markets in New Mexico, Arizona, and California.

The commission also consolidated a fifth application, made by Nevada Natural Gas Pipe Line Co., Las Vegas, with the proceedings. The other applicants are El Paso Natural Gas Co.; Pacific Gas & Electric Co., San Francisco; Southern California Gas Co., Los Angeles; and Southern Counties Gas Co. of California, Los Angeles.

El Paso proposes to expand its pipeline system to supply the four other companies concerned in the proceedings.

Gas Producing Capacity Predicted for 1951-55

By 1955, natural gas producing capacity in the United States will be 9.5 to 11.9 trillion cu ft, as compared with actual 1950 production of 6.9 trillion cu ft, the McCollum committee to the National Petroleum Council has reported.

Terming the estimates "deliberately conservative," the committee said there is room for substantial growth in production and demand for natural gas, and pointed out that the rate of withdrawal without waste from nonassociated gas reserves is subject to considerable range.

The estimates of availability range from 8.1 to 9.5 trillion cu ft in 1951 to the 1955 prediction. Intervening years are estimated as follows: 1952—8.5 to 10.2 trillion; 1953—8.9 to 10.8; 1954—9.2 to 11.4.

FPC Denies Panhandle Plea To Cut Detroit Gas Supply

Economic hardship for Detroit consumers would result from a 30% reduction of natural gas deliveries to Michigan Consolidated Gas Co., Detroit, as proposed by the Panhandle Eastern Pipe Line Co., according to FPC Examiner William J. Costello. In the absence of proof by Panhandle of a depletion of gas supply, Mr. Costello recently filed a decision to deny the request.

Panhandle now provides Michigan Consolidated with 46.5 billion cu ft of gas annually. The proposed cutback would have boosted Michigan Consolidated's needs from its other supplier, Michigan-Wisconsin Pipe Line Co., to 72 billion cu ft annually and created a system-wide 22-billion cu ft shortage on Michigan-Wisconsin's system.

Manufactured gas could not replace such a cutback entirely and would be economically unfeasible, according to the examiner's report. The decision states that the first year cost of manufacturing the 7 billion cu ft of gas to assure continued service to Michigan Consolidated's firm customers has been estimated at $9 million, as compared with $2 million for the same amount of gas purchased from Panhandle. This increased cost would necessarily be paid by the consumers, the examiner asserted.

Temporary Okay Given for Hugoton Overproduction

A Kansas Corporation Commission order dated Feb. 20 granted temporary permission to overproduce Hugoton field gas wells supplying Colorado Interstate Gas Co., Colorado Springs.

Relief from the proration rule that wells shall be shut in when their overproduction exceeds three times their current monthly allowable will avoid depriving domestic users of gas during the current heating season, the order stated.

Colorado Interstate, a non-producer, has completed a 215-mile line from the Texas Panhandle field to help meet its increased demand. Actual operation of the line was delayed, however, awaiting completion of a compressor station and dehydration plant in the Texas field.

Colorado Interstate Plan Okayed by Commission

The Federal Power Commission has authorized Colorado Interstate Gas Co., Colorado Springs, to construct facilities with an estimated total cost of $3,379,532 but conditioned that no new customers or services be added beyond those shown in exhibits presented at the hearing for 1952 and 1953.

Temporary authorization for a portion of the project constructed in 1951 had been granted in December. This included an increase of 1800 hp at the Panhandle field compressor station, a 1320-hp increase at the Kit Carson unit, and construction of 52 miles of pipeline.

The remainder of the project, to be completed this year, will include two additional 1320-hp units at Panhandle field and one additional 1320-hp unit at Kit Carson.

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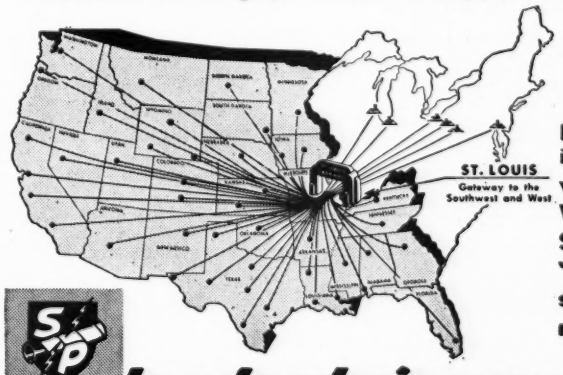
1G	Yes	Yes	Primer	3/32" Enamel	Glass	Kraft				Yes
1XF	Yes	Yes	Primer	3/32" Enamel	Asbestos Felt	2/32" Enamel	Kraft			Yes
1XG	Yes	Yes	Primer	3/32" Enamel	Glass	2/32" Enamel	Kraft			Yes
2F	Yes	Yes	Primer	3/32" Enamel	Asbestos Felt	2/32" Enamel	Asbestos Felt	Kraft		Yes
2G	Yes	Yes	Primer	3/32" Enamel	Glass	2/32" Enamel	Glass	Kraft		Yes
2GF	Yes	Yes	Primer	3/32" Enamel	Glass	2/32" Enamel	Asbestos Felt	Kraft		Yes
2XF	Yes	Yes	Primer	3/32" Enamel	Asbestos Felt	2/32" Enamel	Asbestos Felt	2/32" Enamel	Kraft	Yes
2XG	Yes	Yes	Primer	3/32" Enamel	Glass	2/32" Enamel	Glass	2/32" Enamel	Kraft	Yes
2XGF	Yes	Yes	Primer	3/32" Enamel	Glass	2/32" Enamel	Asbestos Felt	2/32" Enamel	Kraft	Yes

First enamel coating 3/32" thick—subsequent enamel coatings 2/32" thick.



COATING AND WRAPPING-IN-TRANSIT

permits stop-off for processing or storage at St. Louis without freight penalty. When you ship through the St. Louis gateway, you enjoy "through freight rates" instead of the higher combination rates generally used.

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PIPELINE PEOPLE

Cleaner Pipelines Co., North Kansas City, Mo., has announced the appointment of H. D. BRYAN as sales manager. In 1946, after serving four years in the Army, Mr. Bryan was employed by Ludlow Valve Manufacturing Co. as sales engineer in Pittsburgh and was transferred to Houston as branch manager in 1950.

H. D. Bryan
Cleaner Pipelines

W. H. Sedgeman
Fiberglas

Appointment of WILLIAM H. SEDGEMAN as manager of the anti-corrosion products division of Owens-Corning Fiberglas Corp., Toledo, has been announced by the company. He has served successively as sales control department manager, sales and production control department head, general service department manager, and market analysis department head, a position he has held since 1948.

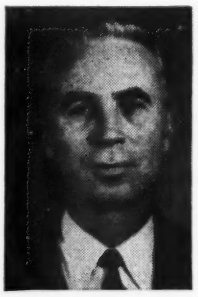
Effective April 1, HERBERT A. HEMPHILL, Texas geologist, was appointed president of Texas Eastern Production Corp., wholly owned subsidiary of Texas Eastern Transmission Corp. Mr. Hemphill resigned from Magnolia Petroleum Co., Midland, Texas, to accept the post. R. H. Hargrove recently resigned as president of the subsidiary in order to devote his full time to the parent company. He continues as a director of the production company, however.

Additions to its sales staff have been announced by Tapecoat Co., Evanston, Ill. V. J. SCAROLA, in charge of the New York office for the past seven years, has been appointed manager of sales and will headquarter in Evanston. The following men will serve with Mr. Scarola: JOHN G. BOLLING, manager of utility sales; JOHN WALSH, manager of industrial sales; BURT SCHMIDT, midwest sales and service; JACK O'BRIEN, western sales, Denver; and LOUIS ZITO, eastern sales, New York.

DR. EMIL H. BALZ has been appointed director of research of Glass Fibers Inc., Toledo. In the past, he has served as a consultant to the firm and has had charge of its glass and plastic laminate laboratory. Under his direction, the Vitron continuous glass cloth treating process was developed at Glass Fibers' Waterville, Ohio, plant.

Southern Production Co. Inc., Shreveport, has elected ELLIOTT H. POWERS as vice president in charge of exploration. Former assistant division exploration advisor in the Houston office of Gulf Oil Corp., he had been employed by that firm since 1935.

New superintendent of natural gas compressor stations operated by Manufacturers Light & Heat Co. and associated Pittsburgh Group companies is H. R. WEITZEL, an employee of the company since 1937. He succeeded M. L. COWDEN, who retired March 1 after 35 years with the firm.

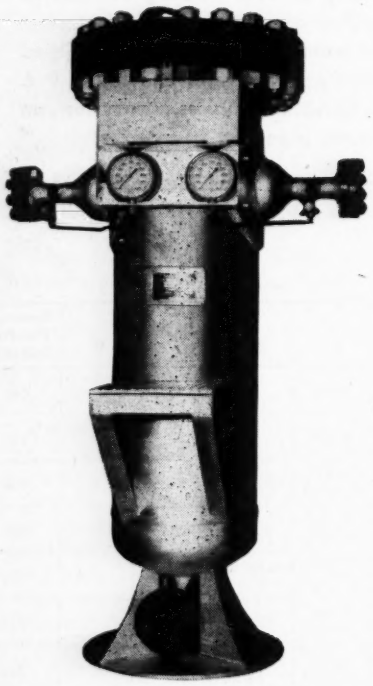


H. R. Weitzel
Manufacturers

R. J. Lawn
Pittsburgh Coke

Appointment of RAYMOND J. LAWN as supervisor of synthetic coatings research has been announced by Pittsburgh (Pa.) Coke & Chemical Co. He will supervise and coordinate the firm's research and development activities and will be responsible for laboratory technical service on synthetic corrosion-resistant industrial coatings.

HOIL ON THE LINE . . .



Hoil's positive dust scrubber assures you clean, dry gas by the dry removal of dust, line scale, and other foreign matter from your gas transmission systems. Dry particles of foreign matter present in the line are blown down instead of scrubbing with oil, thus eliminating oily residue on the downstream side. Hoil Dust Scrubbers are highly adaptable for city gate distribution systems and compressor fuel intakes.

"Hoil Clarifiers" are designed for different working pressures and inlet and outlet sizes depending on your requirements. Easily changeable filter elements are provided, and units can be furnished with a small attached winch and raising equipment making it easy to change filters. Built-in differential gauges, protected by a box attached to the front of the scrubber, show you when to make the necessary infrequent filter change.

Obtain low installation costs, dependable performance, and prompt engineering service by ordering your gas transmission positive dust scrubbers "According to Hoil".

HOIL ENGINEERING CORPORATION

402 North Cheyenne
Tulsa, Oklahoma

C. K. Hood

Worthington Pump & Machinery Corp., Harrison, N. J., has elected C. K. HOOD, former manager of the company's New York district sales office, to a vice presidency. He will direct activities of the public works, steam power, deaerating, water treating, and steam turbine divisions. W. J. VAN VLECK succeeded Mr. Hood in New York and C. W. KRAMER, Birmingham salesman, replaced Mr. Van Vleck as manager of the Atlanta office. I. W. LEGGETT, salesman at Charlotte, N. C., has been named branch manager there. Worthington also has named DONALD W. BEDELL as industrial relations assistant to L. C. Ricketts, vice president in charge of manufacturing, and A. L. JONES as manager of the water treating division.

New chief geologist for New York State Natural Gas Corp., Pittsburgh, is RICHARD J. MURDY. He will be in charge of the firm's work in developing new gas reserves and for the design of underground gas storage pools. SIDNEY S. GALPIN has been appointed an assistant superintendent in the company's Oakford storage district.

J. A. JUSTESON, assistant western sales division manager for Caterpillar Tractor Co. at San Leandro, Calif., has been named eastern sales manager with headquarters in Peoria. Mr. Justeson succeeds W. S. ZEIGLER, now assistant director of sales in the absence of J. W. MOHLER, who is serving with NPA.

Pittsburgh (Pa.) Coke & Chemical Co. has promoted O. E. MCCULLOUGH to manager of its protective coatings division. Mr. McCullough was formerly assistant manager of the division.

PROGRESS REPORTS

Planned

ARKANSAS-MISSOURI POWER CO., Blytheville. Docket G-1900 for a line from Campbell, Mo., to Blytheville, Ark., and a line from Clay county, Ark., to Rector, Ark. The total of 140 miles of pipeline is to serve 13 communities in Arkansas and 5 in Missouri.

ATLANTIC SEABOARD CORP., Charleston, Docket G-1850 for four new compressor stations aggregating 18,200 hp, with additional 1100 hp unit to be installed in existing station, all in West Virginia.

CENTRAL KENTUCKY NATURAL GAS CO., Charleston. Docket G-1905 for 8.8 miles of 20-in. pipeline to parallel an existing section from North Means, Ky., to Cincinnati.

CENTRAL WEST UTILITY CO., Kansas City, Docket G-1682, four alternate plans to serve Clay county, Mo.

CHICAGO DISTRICT PIPELINE CO., Joliet, Docket G-1756 to build 15 mile, 30-in. line in Cook county, Ill.

COLORADO-WYOMING GAS CO., Denver. Docket G-1821 for 2 mile, 3-in. line from Johnstown to Milliken; and 4 mile, 6-in. line to Rocky Flats Plant of the Atomic Energy Commission.

EAST TENNESSEE NATURAL GAS CO., Knoxville. Docket G-1336 for a 100-mile, 16-in. line from near Knoxville to Kingsport, Tenn. with appurtenant equipment.

EL PASO NATURAL GAS CO. Docket G-1631 for 112.9 miles 30-in., 179.5 miles field lines, 98,200 hp added capacity plus 36,540 hp in field stations, field gathering systems, and miscellaneous facilities; 133.3 miles main line loop; 14,800 additional compressor hp in existing stations; 105,000 hp in new and authorized main line booster stations; new field lines and field compressor stations and additions; purification and dehydration plants; field gathering systems; amine recovery plants; and other miscellaneous facilities.

EL PASO NATURAL GAS CO. Docket G-1630 for 25,050 hp at new and existing stations, 50.9 miles field lines, 2700 hp at a field plant, gas wells and miscellaneous facilities; 36.9 miles of main line loop; 32,560 miles in main line compressor hp; field transmission lines, compressor stations and gathering system; dehydration plants; a gasoline absorption plant; gas wells; and communication facilities.

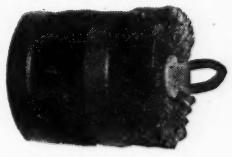
GLACIER GAS CO., Butte, Mont. Dockets G-1816, G-1817, G-1818 for 285 miles of 20-in. from northeast of Kalispell, Mont. to Spokane, Wash.; 91 miles of 8⅝-in. from Spokane to Lewiston, Idaho; 120 miles of 16-in. from Spokane to Hanford, Wash.; 130 miles of 12¾-in. from Spokane to south of Trail, B. C.

HOME GAS CO., Pittsburgh. Docket G-1893 for 32.5 miles of line in Chemung and Broom Counties, N. Y.

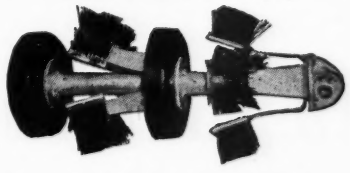
KANSAS NEBRASKA NATURAL GAS CO., Hastings. Docket G-1857. To build 179 miles of line

THE PIG WITH THE POKE — CLEANS PIPE LINES

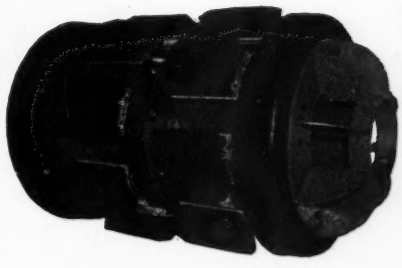
THE VERY LATEST
Williamson Pipe Line Pigs*
FOR CLEANING
NATURAL GAS PIPE LINES



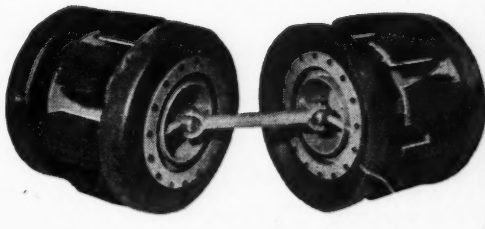
4" Size—TYPE JRN. 2" to 4" sizes. Will pass 1½ R-90° Bends. No valves other than full diameter thru port valves. Use TYPE SCN-51 for 6" size.



8" Size - TYPE WC-11. 8" to 14". Will traverse 6-foot radius field bends, full diameter side openings at 45°. SPRINGS COMPENSATE for BRUSH WEAR.



20" Size - TYPE GP-2. 16" to 30" 200-lb. SPRING forces the brushes against pipe wall — COMPENSATING for WEAR. Will traverse round opening gate or plug valves. SPRINGS and BRUSHES are identical and interchangeable for all types and sizes of GP-PIGS.

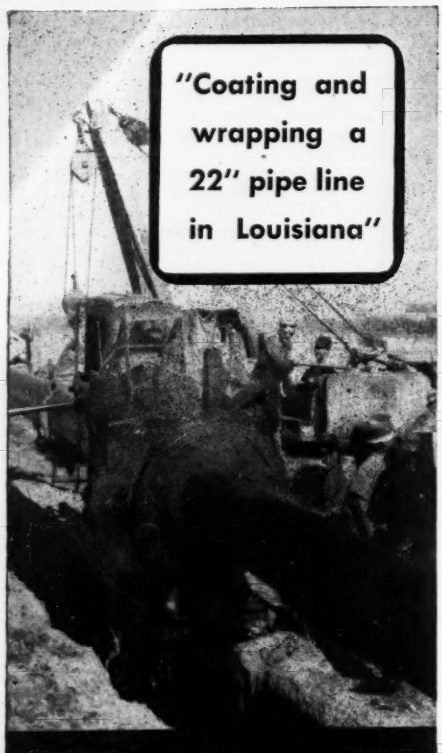


24" Size - GP-3. 18" to 30". Sizes will pass 1½ R-30° Bends. SPRINGS COMPENSATE for BRUSH WEAR ASSURING full section cleaning efficiency.

GP-3 consists of two Type GP-1 Pigs—Each Unit may be used as individual pig.

*Patents Pending

T. D. Williamson, Inc.
TULSA 9, OKLAHOMA



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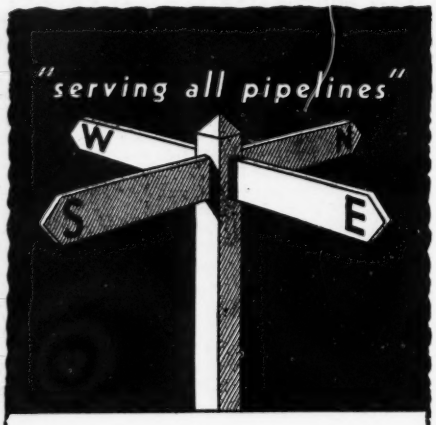

PIPELINE COATINGS
and
WRAPPING MATERIALS

S. D. DAY COMPANY
1973 WEST GRAY HOUSTON, TEXAS PHONE JU-2431

in Kansas and Nebraska and rearrange certain compressors, stub lines and metering stations to serve new main line industrial customers.

MANUFACTURERS LIGHT & HEAT CO., Pittsburgh, Pa. Docket G-1893 for 40 miles of pipeline in Allegheny, Washington, and Beaver Counties, Pa., and Belmont, Jefferson, and Columbiana Counties, Ohio.

MIDSOUTH GAS CO., Little Rock, Ark. Dockets G-1445 and 1680 for 240 miles of line in Greene, Crittenden, St. Francis, Lee, Phillips, Monroe, Woodruff, Poinsett, and Cross counties, Ark.

MISSOURI CENTRAL NATURAL GAS CO., Macon, Mo. Docket G-1509 for 25 miles of 6-in. from Moberly to Macon, Mo.

NATURAL GAS STORAGE CO. OF ILLINOIS, Chicago. To build facilities to develop an underground storage area 15 miles from Kankakee, Ill.

NEVADA NATURAL GAS PIPE LINE CO., Las Vegas. Docket No. G-1888 for 114 miles of 10¾-in. line from Topock, Ariz., to Las Vegas area, Henderson, and Boulder City.

NORTHWEST NATURAL GAS CO. Docket G-996 for 645 miles of 18-, 20-, 22-, and 24-in. line in Washington, Idaho and Oregon together with laterals and four compressor stations aggregating 24,750 hp.

PACIFIC GAS & ELECTRIC CO., San Francisco. Docket G-1651 for 86.25 miles 34-in. loop and 22,789 hp at authorized stations.

PACIFIC GAS & ELECTRIC CO., San Francisco. Docket G-1892 for 20 miles of 16-in. line from Burrell to a point near Easton and 15 miles of 20-in. pipe extending from Helm and joining the system's Topock-Milpitas line in Fresno county; and for 15.5 miles of 12¾-in. in Madera county parallel to the existing Madera-Livingston line.

PACIFIC NORTHWEST PIPELINE CORP., 2175 miles of 26-in. from southern Texas to Seattle, Wash., Vancouver, B. C., via Oklahoma, Kansas, Colorado, Wyoming, Idaho, Oregon, Washington.

PIEDMONT GAS CO. INC., Hickory, N. C. Docket G-1617 for 28 miles 6-in. line.

ROCKLAND LIGHT & POWER CO., Nyack, N. Y. Docket G-1728 for 22 miles transmission line between Orangetown and Tomkins Cove, N. Y.

SOUTHERN CALIFORNIA GAS CO. and **SOUTHERN COUNTIES GAS CO.,** Los Angeles. Docket G-1718 for 14 miles 30-in. line between Whitewater and Desert Center, Calif., 6 miles 30-in. from Blythe, Calif. station to Calif.-Ariz. border, and two 1760-hp compressors at Blythe.

SOUTHERN NATURAL GAS CO., Birmingham. Docket G-1907 for 1254.7 miles of various size pipelines and seven compressor stations totaling 33,300 hp in Alabama, Georgia, Mississippi, Louisiana, and South Carolina.

TENNESSEE GAS TRANSMISSION CO., Houston. Dockets G-1573 and G-1614 for 591 miles of line parallel to existing system, a 304 mile line from near Mercer, Pa. to Utica, N. Y. with a total of 165,000 hp to be installed at new and existing compressor stations.

TEXAS GAS TRANSMISSION CORP., Owensboro. Docket G-1847 for 407 miles 26-in. loop line on sections of existing line between Bastrop, La. and Hardinsburg, Ky. together with installation of 14,620 hp.

TEXAS-OHIO GAS CO., Houston. Docket G-1810 for 1350 miles 30-in. from Hidalgo county, Texas through Arkansas, Mississippi, Tennssee, and Kentucky terminating near Spencer, W. Va. including 13 compressor stations totaling 140,000 hp.

TRANS-CANADA PIPE LINES LTD., for 2200-mile line from Alberta to major cities as far east as Montreal.

UNITED GAS PIPE LINE CO., Shreveport. Docket G-1879 for compressor stations at Napoleonville and Jackson, Miss., for 13,280 total hp; and an addition of 8,000 hp at authorized

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